APPENDIX B
WORKSHOP PACKET OF INFORMATION

Items mailed prior to workshop:

- Agenda
- October 1999 Workshop Proceedings Summary
- Fact Sheets

Items provided at workshop:

- Attendance Record Card
- Evaluation Sheet
- Description of Disposal Alternatives
- Fish Trawl Maps
- Lobster Survey Maps
- Sampling Location Maps
- Ballot for Evaluation Factors

US Army Corps of Engineers
New England District

United States Environmental Protection Agency
Region I

LONG ISLAND SOUND
DREDGED MATERIAL DISPOSAL EIS WORKSHOPS
6:00 - 9:30 p.m.
April 11, 2000 - Port Jefferson, NY
April 12, 2000 - Groton, CT

AGENDA

6:00 p.m. Welcome & Introductions - Larry Rosenberg, US Army Corps of Engineers

Opening Remarks - Roger Janson, US Environmental Protection Agency

Topic Area Briefings
- Ground Rules - Bernward Hay, Louis Berger, Inc.
- EIS Work Plan/Process - Sue Holtham, US Army Corps of Engineers
- Field Work for Open Water Sites - Dave Tomey, US Environmental Protection Agency
- Evaluation of Disposal Alternatives - Dr. Drew Carey, CoastalVision

6:25 p.m. Introduction to Group Discussions

Discussion #1
EIS Work Plan and Field Work

Discussion #2
Site Screening for Open Water and Beneficial Use Alternatives

Discussion #3
Site Screening for Upland Alternatives and Treatment Technologies Alternatives

Synthesis by Facilitators

Working Committee Sign-up (by interested participants)

Open Discussion

9:20 p.m. Closing

Facilitators: John Bleiler, Don Boye, Mark Gerath, Stanley Humphries, Josh Lieberman, Elizabeth Powers, Steve Wolf (ENSR), Drew Carey (CoastalVision)

April 2000

United States Environmental Protection Agency

US Army Corps of Engineers New England District

Long Island Sound Dredged Material Disposal EIS

October 1999 Workshop Proceedings Summary

October 12, 1999 - Port Jefferson, NY

October 13, 1999 - Stratford, CT

Background and Purpose

The U.S. Environmental Protection Agency, Regions I and II (EPA), and the U.S. Army Corps of Engineers, New England District (the Corps), are proceeding with the preparation of an Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA). The EIS will consider the potential designation of one or more dredged material disposal sites in the waters of Long Island Sound (LIS) under Section 102(c) of the Marine Protection, Research, and Sanctuaries Act and 40 CFR 230.80 of EPA's regulations under section 404 of the Clean Water Act (CWA).

To refine the issues to be addressed in the EIS, the EPA and the Corps invited the public to two workshops in October 1999. The purpose of these workshops was to discuss the building blocks for the EIS, specifically:

- The process for screening sites to be evaluated in the EIS
- Data reviewed and to be collected in the preparation of the EIS
- The need for dredging and the alternatives for disposal of the dredged material
- Factors to be evaluated in the screening of sites

To allow for substantive dialogue from the public on the above topics, two evening workshops were held: the first was held on Tuesday, October 12, 1999 at Danford's on the Sound, Port Jefferson, NY; and the second on Wednesday, October 13, 1999 at the Ramada Inn, Stratford, CT.

Workshop Discussions

At each workshop, a set of questions was posed for each topic. The following is a synopsis of the questions posed and the responses received during the workshops. A full report, entitled "October 1999 Workshop Proceedings" dated March 2000 is available and has been posted on the EPA web site for this project at www.epa.gov/region01/eco/lisdreg/.

Site Screening Process

- ***Are the boundaries of the study appropriate?***

- The boundaries of the study area should be identified based on the feasibility of disposal of dredged material generated by LIS projects.
- The study area should be inclusive of any appropriate sites for the type of material generated from LIS projects. Rhode Island (RI) participants requested that if Block Island Sound were included, RI dredging needs should be included in the estimate of dredging volumes and need.
- Any or all areas suitable for disposal of dredged material from LIS projects should be evaluated, regardless of distance or location.
- The study area should be defined based on the source and characteristics of the material to be disposed.

- ***How would you divide the Sound for reviewing disposal options for dredged material? What criteria would you use (land and water)?***

- The attributes of the dredged material should be matched with the attributes of specific types of sites/locations/methods.
- Proximity and the costs of transportation should not be the determinative factor in defining or further subdividing the Sound.

- ***For the existing conditions in the Sound, from your personal experience, is there anyone you know of that we should be talking with?***

- Non-profit research groups and academic institutions, harbor management associations, port users, fishermen, fishing clubs, yacht clubs, muncipalities, etc.
- The study team should reach out to groups like commercial fishermen, who might not be inclined to attend workshops.

- ***Is there anything else you would add?***

- Provide information in layman's terms and reach out to the "fringe audience" (e.g. recreational fishermen).
- Make sure that MPRSA criteria are followed (i.e. the dumping of only clean sediment in open water).
- GIS is essential to the screening of sites.

Data Review and Recommendations

- ***Are the listed four priority areas dealt with in a comprehensive manner?***

- Proposed sampling at historic dredged material disposal mounds may not provide a very realistic picture of "worst case" impacts because the material has been in place on the bottom for a relatively long period of time -- the original contaminant levels may be considerably lower now than when the material was first placed on the seafloor.
- If potential disposal sites other than the four existing ones are to be investigated, then a very different set of data will probably need to be collected.
- Regarding bioaccumulation sampling, relating contaminant levels in organisms to exposure at the disposal sites is a problem, since organisms are known to migrate throughout the Sound. In particular, juvenile organisms spend most of their lives in harbors and could be exposed to contaminants there as opposed to at the disposal sites.

- ***What other priority areas should be investigated?***

- Characterization of the material that needs to be dredged (i.e. pre-dredged material in the harbors). Need to know the contaminant levels in the material requiring dredging and how these levels compare to those at the disposal site(s).
- Historic analysis should be performed to look at the degree of correlation between the bulk sediment chemistry of the pre-dredged material and its toxicity.
- Need to conduct a type of "risk" or "cost/benefit" analysis to evaluate the dredge versus no dredge alternative.

- ***The sampling recommendations - are they complete? If not, why not?***

- The contaminants of concern should be based on those contaminants that are typically found in the harbors.
- Need greater detail on the tissue sampling protocol. What tissue specifically will be sampled (e.g. lobster muscle, tomalley, liver?)
- Concern about recent lobster kill in western LIS. The lobster mortality event has significant implications for the planned bioaccumulation sampling in support of the EIS.

- ***What other field work would you want to see?***

- Lobster density and population should be examined relative to actual location of disposal mounds.
- Conduct direct measurements of sediment deposition at each site.
- Need comprehensive mapping of sediment types in LIS.
- Need data on waves in LIS, which may be useful for evaluating erosion potential of nearshore disposal alternatives.
- Look to historic sites to provide an indication of future conditions at the existing sites.

Dredging Needs and Disposal Alternatives

- ***What do you think are the limitations on transportation of dredged material?***

- Primary issue is cost of transportation. Higher costs are a function of long distances, poor weather, numerous transfers, high volumes of material, treatment protocol, price of fuel, and overall logistics.
- Small local dredgers can't be expected to travel long distances to disposal sites and could be forced out of business
- Beneficial use should pay for itself and the costs should be borne by those benefiting.

- ***Are there any specific alternative sites or methods you can recommend? This may include historical or existing sites. If so, where can we find more information?***

- Clean sand should be made available for beach nourishment.
- Use numerous smaller disposal sites, closer to the dredge site and not just the four existing sites.
- Most discussion covered alternative methods, like geotextile material to bag or encapsulate contaminated material and use of methods that don't entrain as much water in the dredging process. Develop methods that enable the disposed material to provide other benefits, like material used in breakwater construction to benefit shoreline protection. Consider artificial islands.
- More information needed on capping, upstream controls of sedimentation, use of brownfields, strip mine reclamation, infilling of borrow pits, reclamation sites and CDFs.

- Reconsider disposal near the entrance to harbors-historical, non-federal, harbor-related sites. Avoid lobster impacts in deep holes.

- ***Do these alternatives seem feasible to you? And why?***

- Thermal, chemical and biological treatment methods not well known or understood. These treatments were cited as too costly, necessary to have dewatering, resulting in byproducts and requiring too much handling.
- CDFs and CADs seem less costly, more controlled and easier, but others noted habitat loss and environmental impacts associated with CDFs and CADs.

- ***Is there anything else you would add?***

- Dredging needs would be reduced if sources of the sediment load could be identified and reduced. Upland sedimentation should be controlled.
- An important ecological benefit of dredging is the improved flushing of the estuarine and harbor systems.

Evaluation Factors for Site Screening

- ***Is this list of evaluation factors comprehensive?***

- The list is generally comprehensive.
- There is a need to provide a systematic weighting of the evaluation factors either quantitatively or qualitatively.
- Clearly link the factors to existing laws and statutes, such as the CWA and MPRSA.
- Need to balance potential short-term and long-term economic and environmental impacts at a specific dredge site with long-term economic viability of interests that are dependent upon the use of navigable waterways.

- ***Using the evaluation factors -- how would you further define the goals? Why?***

- A primary goal of the EIS should be to identify environmentally sound, economically feasible solutions.
- Terms like "minimize" and "maximize" should be better defined and not vague. How to measure compliance would be problematic.
- Ecological restoration of degraded habitats should be a primary concern. Food chain uptake of environmental constituents and protection of marine resources should also be primary goals.
- Economics, particularly of water-dependent uses, should be primary goals. The impacts of the no-dredge alternative should include the effects of not dredging on commerce and public safety.
- Goals should consider means to maintain or reduce the costs of testing and disposal of dredged material.

- ***Using the evaluation factors - how would you further define the evaluation basis? Why?***

- Economic, biological, and physical bases were determined to be critical bases for evaluation of alternatives.
- The bases need to be carefully weighted in a site-specific manner.
- A risk-based approach may help to avoid the need to make absolute determinations, and to help streamline the evaluation process.
- Cumulative factors (e.g. secondary, and tertiary economic/environmental impacts) need to be considered.

- ***Are there more that you would like to add?***

- The public needs to be involved in the EIS process, including evaluation and selection of sites to be analyzed.
- Concern that the process might be weighted towards selection of the existing four open water disposal sites.
- Need to use GIS and provide an example of application of the evaluation factors to the site screening process.
- Dredging can be both environmentally and economically beneficial, and the EIS process clearly needs to focus on the positive aspects of dredging (e.g. maintaining the economic viability of water-dependent uses, environmental restoration, public safety, developing alternative transportation corridors).

Fact Sheet #1 - April 2000

United States Environmental Protection Agency

US Army Corps of Engineers
New England District

Long Island Sound Dredged Material Disposal EIS

Evaluation of Disposal Alternatives

Background

In October 1999, the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (the Corps) hosted workshops to discuss building blocks for the Environmental Impact Statement (EIS) for the designation of dredged material disposal site(s) in Long Island Sound. One of the topics discussed was the process for screening and evaluating disposal alternatives. This screening process is to be based on a set of evaluation factors that were also presented and discussed. During those workshops, attendees requested that the evaluation factors be linked clearly to the criteria of the Marine Protection, Research and Sanctuaries Act (MPRSA) and other environmental regulations, and be weighted in terms of importance to the stakeholders. In response, the EPA and the Corps, with input from other federal and state agencies, is proposing a strategy and process for weighting those factors in the screening of disposal alternatives. The results will be used to identify alternatives to be analyzed in the EIS. We invite the public's input on a proposed approach, as described below.

Methods Considered for Weights and Values

The EPA and the Corps reviewed various methods for assigning weights and values to the evaluation factors. The assignment of weights and values will be a highly iterative and interactive process. Pros and cons of each approach were considered. Various methods include quantitative mathematical approaches; application of professional judgment of technical experts; and assignment of values by multi-interest stakeholders. Some methods allow for independent scoring by participants; others require consensus. Some methods provide for early input of weights/values from diverse interests; with other methods, differences may arise late in the process during the evaluation of specific sites. Some methods rely on technical expertise of a small group; others rely on public opinion of a large, potentially disparate group. Some are complex to implement, while others may appear more expeditious early on, but have a greater chance of complexity toward the end of the process. The variety and number of interests represented in the process directly correlates to the balancing of interests involved in the assignment of values. For example, are environmental and economic concerns assigned equal weight?

With all these considerations, the EPA and the Corps, with input from stakeholders, federal and state agencies, wish to apply an approach that takes the best from each of the different approaches and minimizes the negatives. As a result, a "blended" approach is proposed.

Proposed Approach

The proposed approach blends the best of all considered methods: early and ongoing input; customized scoring; and geographic information system (GIS) support.

Early/Ongoing Input

The proposed approach provides for the early and ongoing input from a broad base of stakeholders, technical and regulatory experts in assigning weights and values.

Scoring

The proposed approach includes flexibility in the assignment of scores for each factor based on such characteristics as presence or absence of a significant resource (such as Threatened or Endangered species); or high (H), medium (M), and low (L) impact, as pertinent. For example, H, M, or L may be sufficient for those factors that aren't well-suited to quantitative scoring. Scoring metrics could include engineering considerations (such as site acreage), a numeric scale (such as 1-10), or other methods.

GIS Support

The proposed approach employs a geographic information system (GIS) database for assisting the participants in testing the results and integrating rankings with the screening process. For example, if there is an important environmental resource and it is represented by an "H", the participants can see how much area is excluded from consideration for site selection and if lesser or greater distances are more appropriate.

Stakeholder Process Groups

Three interacting groups are envisioned, as shown in Figure 1. The proposed process employs a combination agency/technical/stakeholder team structure based on the type of alternative to be addressed.

Planned are multiple reviews and revisions at various stages of the alternative site screening process, from development of the overall framework to specific assignment of weights and values to individual evaluation factors, to the evaluation of specific disposal alternatives and site screening.

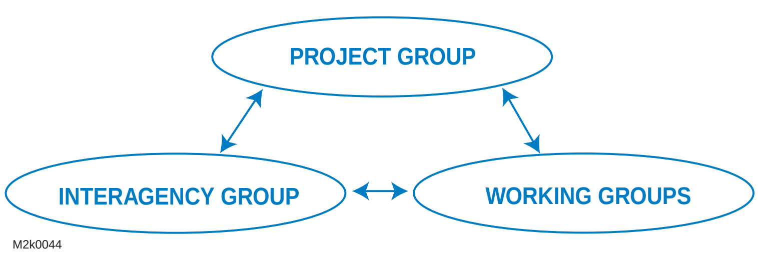


Figure 1
LIS EIS
Stakeholder Group Process

These groups may conduct concurrent reviews as information is developed.

- **Project Group** - U.S. Environmental Protection Agency (EPA) Regions 1 and 2 and the New England and New York Districts of the U.S. Army Corps of Engineers (the Corps).

- **Interagency Group** - Participation from federal and state agencies. This group will provide input to the overall framework and provide regulatory guidance to the process. These group members will provide first cut review and comment on the proposed framework and strategies provided by the project group. The project group then revises initial proposals based on that review. Proposed representatives include:

  - National Marine Fisheries Service (NMFS)
  - U.S. Fish and Wildlife Service (FWS)
  - Office of Long Island Sound Programs (OLISP)
  - Connecticut Department of Environmental Protection (CTDEP)
  - New York Department of State (NYDOS)
  - New York State Department of Environmental Conservation (NYSDEC)
  - Empire State Development Corporation (ESDC)
  - New York City Economic Development Commission (NYEDC)
  - Rhode Island Coastal Resources Management Council (CRMC)
  - Rhode Island Department of Environmental Management (RIDEM).

- **Working Groups** - The public's participation is invited to serve on various working groups. The groups will be responsible for rolling up their sleeves in the evaluation of disposal alternatives. One of the steps will be to determine the weights and values to be applied to the screening of disposal alternatives. The groups will be organized according to the following topics:

  - Open Water Disposal
  - Beneficial Use of Dredged Material
  - Upland Disposal
  - Treatment Technologies.

Steps Proposed to Assign Weights and Values

Step 1 - Present and Review Draft List of Evaluation Factors

At the October 1999 workshops, evaluation factors were presented and discussed for the various disposal alternatives. For each alternative, specific factors and goals were listed.

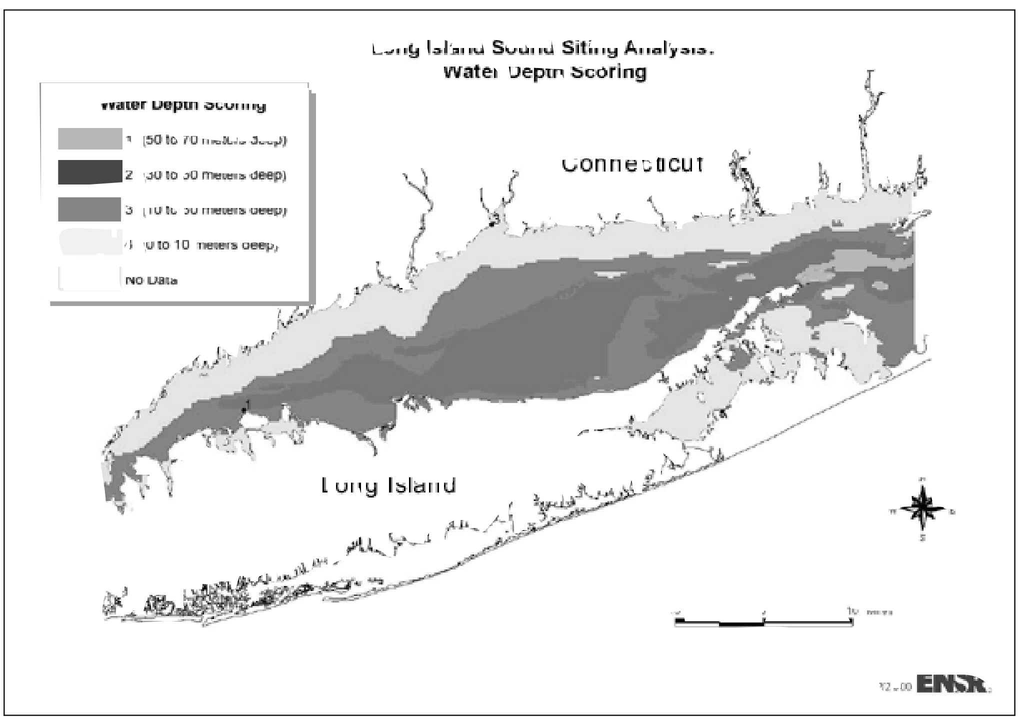
Step 2 - Draft Scoring Approach Strategy

The project group drafted an approach (as described in this fact sheet) based on the evaluation factors as reviewed at the public workshops in October 1999. A scoring approach is proposed for each of the disposal alternatives. An example is provided in the table (next page) for each type of alternative.

Step 3 - Create Working Groups, Refine and Implement Process

Participation on working groups will be solicited at the April workshops. As follow-up to the workshops, the individuals on each team will be expected to roll up their sleeves and review, revise and further refine the proposed factors and scoring approach and go through the site selection process. The screening and selection of candidate sites will be assisted through the application of the GIS database for the Sound. These efforts will be provided to the project and interagency groups and further refined, based on a highly iterative and interactive process. A final decision on the alternatives to be evaluated in the EIS will take into consideration all input and recommendations gathered from the groups.

Example of GIS Application to Scoring



The figure above shows an example of scoring for water depth, in which water more than 50 meters deep is scored “1” for most suitable, down to water shallower than 10 meters, scored “4” for least suitable.

Example of Scoring Approach

Evaluation Factor	Scoring Basis	Metric
Open Water Disposal		
Existing Habitat Types		
Mudflats and Sandflats	Distance, Current direction	H, M, L, 0
Spawning/Nursery Habitat		
Submerged Aquatic Vegetation		
Fisheries Feeding/Migration Habitat	Specific species info	H, M, L,
Benthic Habitat (i.e. unique, hard bottom) mussel, complex habitats	Presence/Absence Descriptive categories of habitats to avoid to avoid	U, H, M, L, 0
Beneficial Use		
Site Characteristics		
Physical Area	Size of site (sq. ft.)	Minimum size
Site Capacity	Capacity of site (c.y.)	Minimum capacity
Current Patterns, Water Circ.	Ranges of near-bottom current velocity, potential for change	U,H,M,L,0
Exposure to storm events, boat wakes	Wave climate	U,H,M,L,0
Ambient sediment conditions/type	Depositional, reworking erosive	H,M,L,0
Bathymetry	Depth	H,M,L,0
Upland Sites		
Threatened & Endangered Species		
Federally Listed Threatened and Endangered Species	Presence/Absence	U/0
State Listed Rare/Endangered Species or those of State Concern	Distance/Migratory Patterns, Species Description, Range	H,M,L,0
Treatment Technologies		
Impacts and Effectiveness		
Airborne Discharge of Contaminants	Type, emissions, distance from receptors	U,H,M,L,0
Noise of Operations	Decibels, distance, duration, intensity	
Stability of Product	Contaminant isolation	Yes, No, degree
Reduction in Contaminant Availability	Contaminant elimination	Yes, No, degree

Key:

U = Unacceptable H = High impact M = Moderate impact
L = Low impact 0 = No impact

For more information, please contact Ann Rodney, US EPA, 1 Congress Street, Suite 1100, CWQ, Boston, MA 02114-2023, 617-918-1538 (tel), 617-918-1505 (fax), rodney.ann@epa.gov (email), or visit our Web Site at www.epa.gov/region01/eco/lisdreg/.

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Fact Sheet #2 - April 2000

United States Environmental Protection Agency

US Army Corps of Engineers
New England District

Long Island Sound Dredged Material Disposal EIS

EIS Work Plan and Process

Background

The U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (the Corps) are preparing an Environmental Impact Statement (EIS) that will consider the potential designation of one or more dredged material disposal site(s) in the waters of Long Island Sound (LIS). This proposed action is required under Section 102 (c) of the Marine Protection, Research and Sanctuaries Act (MPRSA) and 40 CFR 230.80 of the regulations of the EPA under Section 404 of the Clean Water Act (CWA). The EIS will be prepared in accordance with the National Environmental Policy Act (NEPA), and the Council on Environmental Quality (CEQ) Regulations (40 CFR 1500 et. seq.).

Dredged material has been disposed of at the existing sites known as the Western Long Island Sound (WLIS), the Central Long Island Sound (CLIS), the Cornfield Shoals (CSDS), and the New London Disposal (NLDS) sites pursuant to programmatic and site designation EIS's released by the Corps in 1982 and 1991. This site-designation EIS will provide the information needed for EPA's decision on whether one or more dredged material disposal sites will be designated under the MPRSA and identified in advance under the CWA. The EIS will include analyses applying the five general and eleven specific site selection criteria for designating ocean disposal sites presented in 40 CFR Parts 228.5 and 228.6 and the CWA Section 404(b)(1) guidelines. In addition, the impact criteria in 40 CFR 228.10 will be used to assess impacts of the current use of the existing sites and alternative open water sites.

What's in the EIS

An EIS provides information on the effects of the proposed action and alternatives on environmental and socioeconomic resources. This enables the decisionmaker (in this case, the EPA) to make an informed decision as required by NEPA. To arrive at a decision on site designation, the following information will be included in the EIS:

- The purpose and need for designation of one or more dredged material disposal site(s) in the waters of LIS
- A description and evaluation of alternatives to disposal of dredged material at the existing open water sites
- A description of the affected environment, including the general setting of LIS and for each site evaluated
- An assessment of the environmental and socio-economic effects, including direct, indirect and cumulative impacts of alternatives to dredged material disposal at the existing open water sites
- A ranking of the disposal site alternatives
- A review of the proposed action's compliance/ consistency with environmental laws, regulations and programs
- Site management and monitoring plans for open water sites
- A summary of the EIS public involvement process.

Work Plan

The Work Plan includes tasks to be conducted before the EIS document is prepared. These tasks are listed below. Many already have been initiated.

- Public involvement plan preparation and implementation
- Dredging needs inventory
- Identification of alternatives
- Alternative site screening process

- The boundaries of the study area (called the Zone of Siting Feasibility, or the ZSF)
- Data review to identify gaps and initiation of a field program to collect data needed to characterize the existing environment within the ZSF.
- Preparation and distribution of the document for public review and comments, first as a draft and then as a final
- Record of Decision (ROD) and a Final Rulemaking on the decision.

These steps are further described below.

Public Involvement Plan

The public involvement activities have begun on this EIS. A Notice of Intent announcing the EIS process was published in the Federal Register on June 3, 1999. Three public scoping meetings were held in June 1999 in Stony Brook, NY and Groton and Stamford, CT. A report titled "Long Island Sound Site Designation, Environmental Impact Statement: Summary of Scoping Meetings" provides an overview of the comments and issues presented at the meetings. Public workshops were also held in Port Jefferson, NY and Stratford, CT in October 1999. Four fact sheets (October 1999) were produced on the topic areas titled as follows:

- Dredging Needs and Alternatives
- Data Review and Recommendations
- Site Screening Process
- Evaluation Factors for Site Screening.

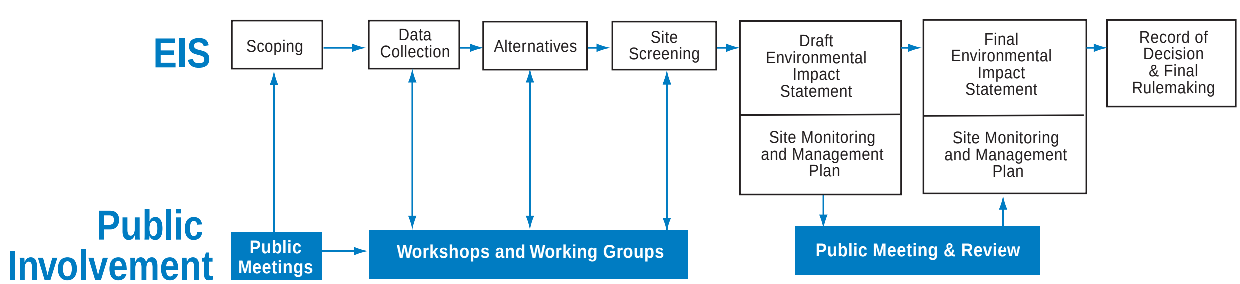
These topics were the focus of small group discussions to get public input on these issues. Comments provided at those workshops are summarized in a report titled "October 1999 Workshop Proceedings". The October series of fact sheets are available for downloading at EPA's LIS Web Site: *www.epa.gov/region01/eco/lisdreg/.*

At the workshops scheduled for April 2000 in Port Jefferson, NY and Groton, CT, the public is invited to learn more about the specific plans for the EIS and to provide comments and suggestions as the Work Plan goes forward. The Work Plan is a flexible, evolving document that will be continually modified and detailed as the EIS progresses. The Work Plan is available on the EPA's LIS Web Site.

The public is invited to actively participate in the preparation of the EIS as well to provide review and comment at critical points during the process. Depending on individuals' time constraints and degree of interest in specific topics, there are varying levels of input and involvement available to the public.

- ***Fact sheets*** are being prepared and distributed to a wide-reaching distribution list to inform the public as the project progresses.
- ***Workshops*** are being held at critical points in the process to receive input on tasks recently completed and on recommendations regarding the next step in each task
- ***Working groups*** will be established for input on the selection of alternatives and ultimately the screening and selection of sites for analysis in the EIS. These groups will also be actively involved in providing input and recommendations to the information gathered for the EIS. These groups will include representatives from EPA, the Corps, other federal, state and local agencies, and members of the public who volunteer and commit to rolling up their sleeves in resolving critical issues associated with key decisions as the EIS process continues.

LIS EIS
Public Involvement Process



Dredging Needs Inventory

The dredging needs inventory is important to characterize both the volume and quality of dredged material in need of disposal over the next 20 years. This inventory will address historic trends and will project future volumes. A review of historic projects has been initiated and an assessment of future volumes will be conducted based on interviews with harbor users within the coastal communities of LIS. Each harbor in Connecticut, New York and Rhode Island (east to Point Judith) will be included in the analysis. Data/projections will be described by source (e.g. federal civil works, other federal, state and municipal, and private) with assumptions made as to the anticipated quality of the material and suitability for alternative disposal sites/methods.

Alternatives

As required by NEPA, the EPA and the Corps will evaluate the existing disposal sites, and additional alternatives including other open water disposal sites, other types of dredged material disposal and management, and the no action alternative. Specifically, four types of disposal alternatives are under consideration: open water disposal; beneficial reuse; upland disposal; and treatment technologies. Also considered will be the "no action" (or "no designation") alternative.

The alternatives section of the EIS will discuss and contrast alternative disposal sites and methods, including those which are not considered reasonable or feasible. Different types of disposal (e.g. containment islands, nearshore sites, borrow pits, confined aquatic disposal sites, and beach nourishment) will be evaluated and a matrix prepared comparing benefits, impacts and costs of each. Each alternative site resulting from the screening process will be evaluated and ultimately ranked based on environmental factors, economic feasibility and engineering feasibility.

Affected Environment

The affected environment is defined as the Zone of Siting Feasibility (ZSF). Since the October 1999 workshops, the ZSF has been defined for each of the alternative disposal options.

- *Open Water Disposal* - From Hell's Gate eastward through LIS, to Fishers Island, Gardiners Bay, Peconic Bay, the waters adjacent to Montauk, NY, to Block Island Sound as far east as Point Judith, RI.
- *Upland Disposal* - All lands within the following political jurisdictions:
    - New York - Westchester, Bronx, Queens, Brooklyn, Suffolk and Nassau counties
    - Connecticut - All counties in the state
    - Rhode Island - Washington county
- *Beneficial Uses* - The area within both the Open Water Disposal ZSF and the Upland Disposal ZSF

The ZSF for Confined Disposal Facilities (CDF) is a subset of the beneficial use areas and includes the open waters of LIS and upland areas to the inland boundary of the states' respective coastal zones.

For each of the ZSF's, biological, physical, chemical, socioeconomic and cultural resources will be described. Existing data will be used as well as information gathered through field investigations and interviews. A general section will be included in the EIS that describes the setting for the entire LIS region. For the existing and alternative open water sites, the description will be specific to each candidate disposal site. For upland and beneficial use sites, a general setting description will be followed by a description of the range of sites considered. The following is a list of topics to be addressed in the section describing the **entire LIS region.**

- *Physical setting:* water quality, geology, meteorology, physical oceanography
- *Biological resources:* plankton, benthos, fish and shellfish, wildlife, endangered and threatened species
- *Socioeconomic resources:* general fishing activities, shipping/navigation, beaches, parks/natural areas, historic and archaeological resources, other human uses (swimming, recreation diving, cable pipeline locations, military, mining activities).

For the existing and alternative **open water sites**, the following resources will be described.

- *Physical setting:* water quality, sediment quality, side scan sonar data, bathymetry, current speed and direction
- *Biological resources:* benthos, fish, shellfish and fishing activities
- *Socioeconomic resources:* other human uses, including potential for historic shipwrecks.

For **upland and beneficial use sites,** the following resources will be described:

- General setting and land uses and zoning
- Soils, vegetation
- Water resources (surface and ground)
- Biota (wetlands, aquatic life, wildlife, endangered species)
- Historic and archaeological resources
- Socioeconomic resources
- Human uses.

The analyses will be supported with graphic output from the geographic information system (GIS) database for the region.

Environmental and Socioeconomic Consequences

The impact analyses will be highly analytical and in depth, based on a thorough review of the scientific literature and studies both through research and data collected by the Disposal Area Monitoring System (DAMOS) program and the field efforts, and through studies and current research. The analyses will be based on the site selection (228.5 and 228.6) and impact criteria (228.10) in the MPRSA and, as applicable, Section 404(b)(1) guidelines and other pertinent federal and state laws and regulations. Any applicable models will be used to quantify impacts as much as possible.

For each type of disposal method and candidate sites (open water, beneficial, upland and treatment technologies) the temporary, short-term and long-term direct, indirect and cumulative effects will be assessed, applying the same categories described for the affected environment.

Compliance/Consistency with Environmental Laws, Regulations and Programs

For the preferred disposal alternative, the appropriate federal, state and local environmental laws, regulations and programs will be reviewed, including the following:

- Clean Water Act , Section 404 (b)(1) guidelines
- MPRSA site selection criteria
- Coastal Zone Management Act (for Connecticut, New York and Rhode Island, if applicable)
- Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act
- National Historic Preservation Act
- Fish and Wildlife Coordination Act
- Marine Mammal Protection Act
- Clean Air Act
- Appropriate Federal Executive Orders and Memorandums
- Appropriate state or regional comprehensive conservation and management plans.

Preparation of the Draft and Final EIS

The above-described analyses will be presented in a Draft EIS and distributed for public review and comment as required by NEPA. Following a public meeting and review, all comments will be considered, and a response to comments will be prepared. A Final EIS will be prepared based on the comments received on the Draft EIS.

Development of Draft and Final Site Monitoring and Management Plans (SMMP)

For any open water site proposed for designation, a draft and final Site Monitoring and Management Plan (SMMP) will be prepared as required under Sections 102 (c)(3) of the MPRSA. The SMMP(s) will be prepared as stand-alone document(s). Summaries of the plan(s) will be included in the EIS.

Record of Decision and Final Rulemaking

The Record of Decision (ROD) will be published in the Federal Register along with the Final Rulemaking.

For more information, please contact Ann Rodney, US EPA, 1 Congress Street, Suite 1100, CWQ, Boston, MA 02114-2023, 617-918-1538 (tel), 617-918-1505 (fax), rodney.ann@epa.gov (email), or visit our Web Site at www.epa.gov/region01/eco/lisdreg/.

Fact Sheet #3- April 2000

United States Environmental Protection Agency

US Army Corps of Engineers
New England District

Long Island Sound Dredged Material Disposal EIS

Field Work for Open Water Sites

Background

The U. S. Environmental Protection Agency (EPA) and the U. S. Army Corps of Engineers (the Corps) are preparing an Environmental Impact Statement (EIS) that will consider the potential designation of one or more dredged material disposal site(s) in the waters of Long Island Sound (LIS), as required under Section 102 (c) of the Marine Protection, Research and Sanctuaries Act (MPRSA) and 40 CFR 230.80 of the regulations of the EPA under Section 404 of the Clean Water Act (CWA). The EIS will be prepared in accordance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) Regulations (40 CFR 1500 et. seq.).

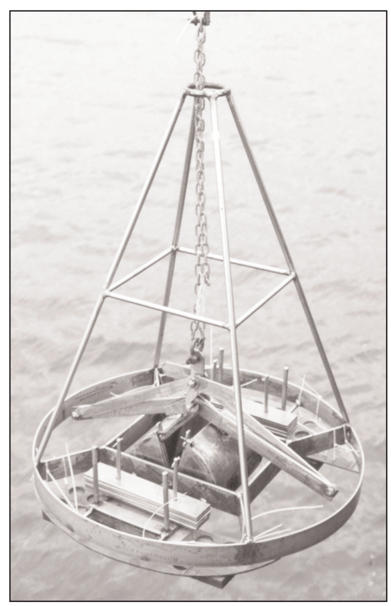
To provide baseline information on LIS, the EPA and the Corps reviewed and evaluated existing data to determine data collection needs. Based on that review, the EPA and the Corps are gathering data on all the alternatives to be evaluated in the EIS, including open water sites, beneficial use sites, upland disposal sites and treatment technologies. As an early task of this data collection effort, the EPA and the Corps identified data gaps associated with open water disposal. As reported at the October 1999 workshops and presented in a fact sheet titled "Data Review and Recommendations," data gaps associated with open water disposal sites were identified in four priority areas:

- *Sediment chemistry* - Distribution of contaminants of concern in sediments at, and immediately around, each active disposal site in LIS
- *Tissue chemistry* - Distribution of contaminants of concern in tissue of shellfish (including lobsters), finfish and benthic invertebrates, at and immediately around, each active disposal site in LIS.
- *Physical oceanography* - Physical oceanographic data from LIS that may be applicable to disposal site designation, including general circulation, wave, and current information relevant to each active disposal site in LIS, and in proximity to those sites.
- *Fishing resources and activities* - Commercial and recreational fisheries resources and activities in proximity to the active disposal sites in LIS, including any baseline fish, shellfish, and lobster data.

The field data collection effort is underway. The field work is being coordinated with other federal and state agency efforts scheduled for the calendar year 2000, including finfish trawl surveys planned by the Connecticut Department of Environmental Protection (CTDEP). This fact sheet provides a status report on the field work necessary to assist in the preparation of the EIS baseline and impacts analyses.

Sampling Program Overview

The overall field program associated with the open water disposal alternative includes the collection of sediment samples, benthic samples, and lobster and finfish tissue samples within LIS. It also includes collection and analysis of data regarding currents, waves, temperature, salinity and other physical



Ted-Young grab sampler modified with landing pads to facilitate sampling in soft bottom conditions. (Feb. 2000)

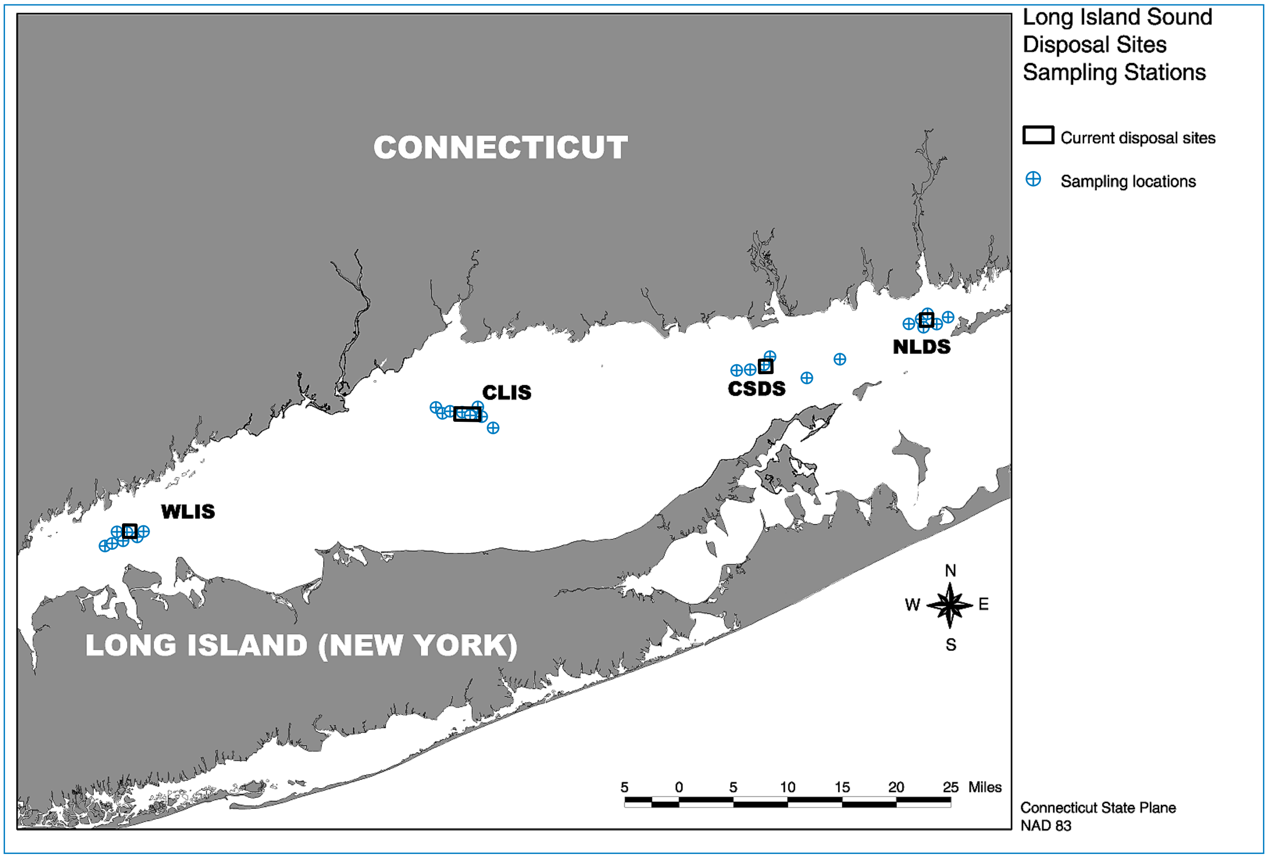


Figure 1. Long Island Sound Disposal Sites and Sampling Stations

oceanographic characteristics of LIS. This data will be used in evaluating baseline conditions within the open water of LIS, including the four existing disposal sites, referred to as Study Areas. The Study Areas are:

- Western Long Island Sound (WLIS)
- Central Long Island Sound (CLIS)
- Cornfield Shoals (CSDS)
- New London (NLDS).

As reported below, an extensive sediment sampling effort was conducted during February 2000. Planned for future seasons are the collection of lobsters and finfish, physical oceanographic data and additional sampling of benthic species in LIS.

Winter 2000 Field Survey - Sediment Sampling

During the week of February 14, 2000, the EPA and the Corps conducted sediment sampling for the analysis of sediment chemistry and the characterization of the local benthic communities at the four Study Areas (see Figure 1). For each Study Area, sediment samples were collected within each of four distinct geographical areas:

- ***Historical*** - areas that received dredged material prior to the onset of testing requirements in 1979
- ***Active*** - areas that have received dredged material deemed suitable for open-water disposal
- ***No impact*** - areas that should have no discernible impacts from the disposal of dredged material, i.e., a "reference site" for each Study Area
- ***Far field*** - areas outside of existing site boundaries suitable for evaluating for any distant effects of disposal of dredged material within LIS.

At each sampling station, five (5) discrete grabs (125 total grabs) were taken in order to obtain enough material for the determination of physical, chemical, and toxicological properties.

The sampling procedure is shown in Figure 2. A grab sampler was deployed from the survey vessel F/V Isabelle to retrieve bottom sediments. Sediments from each grab were divided up for different types of analyses. These included:

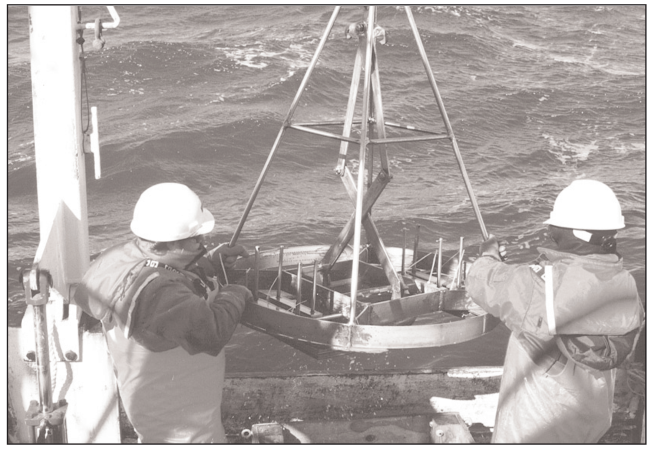
- ***Chemistry*** - the chemical analysis of the sediments.
- ***Toxicity*** - the exposure in the laboratory of a benthic species to the collected sediments to determine if the sediments are toxic to the species.
- ***Biology*** - the benthic species found within the sediment sample to identify the composition of the biological community to include diversity and populations present.

In total, over 1,100 samples were collected and delivered to laboratories for chemistry, grain size and toxicity analyses.

During the collection of sediment samples in the Winter 2000 survey, provisions were made for the collection of benthic invertebrates for potential analysis of tissue samples for bioaccumulation. However, given the season and associated water temperature, limited invertebrates were collected during this survey.

Chemistry/Physical Testing

From the samples collected at each station, sediments will be analyzed for a list of contaminants, including metals, polychlorinated biphenyls (PCBs), pesticides, polyaromatic hydrocarbons (PAHs), acid volatile sulfides/simultaneously extractable metals, bis(2-Ethylhexyl)phthalate, dioxins/furans, dioxin-like PCBs, tributyltin, total organic carbon (TOC), radiochemistry, and for percent water and grain size. Sediments will be tested in accordance with "Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual, EPA-503/8-91/001, February 1991," commonly referred to as the "Green Book" and the U.S. Army Corps of Engineers New England District "Inland Testing Manual



Recovering the 0.1m² Ted-Young grab sampler. Feb. 2000

(ITM) for Dredged Material Disposal Activities" dated July 7, 1998, as appropriate, and as supplemented by additional guidance.

Toxicity Testing

From the samples collected at each station, a portion of the sediment material was collected for toxicity analysis. Following the procedures outlined in the publication: EPA, 1994 "Methods for Assessing the Toxicity of Sediment-associated Contaminants with Estuarine and Marine Amphipods," EPA 600-R-94-025, June 1994, toxicity testing will be performed with the amphipod *Ampelisca abdita*. This amphipod will be exposed in the laboratory to collected sediment as a measure of the toxicity of the sediment to benthic resources.

Benthic Community Analysis

Three additional grabs were performed at 21 stations to collect materials for benthic community analysis. These samples were transferred to a clean 5-gallon plastic bucket where they were rinsed with local seawater. After a careful filtering and sieving of the material, the consolidated sample was then removed from the sieve and transferred to sample bottles. Local seawater was then added to the sample, after which the sample was preserved. The samples collected will be identified and counted to determine the diversity and population of benthic invertebrates in the existing marine ecosystem.

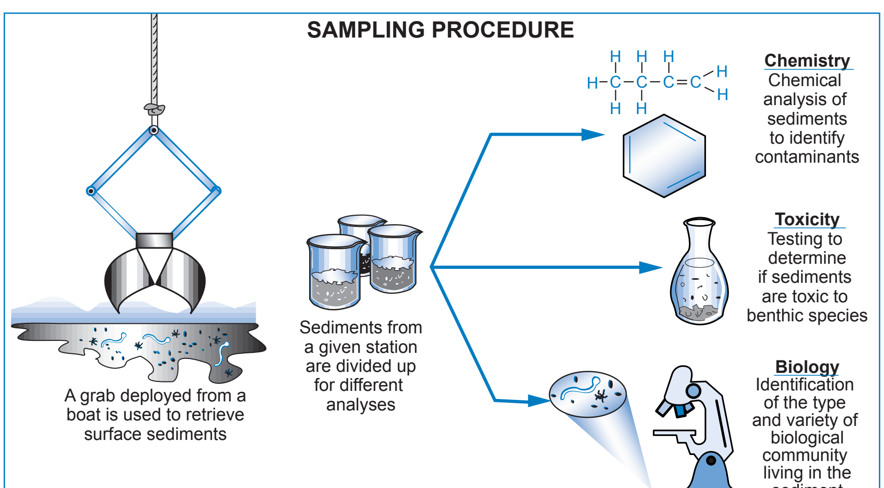


Figure 2. Sampling procedure

Upcoming Investigations

Tissue Chemistry

Plans are currently being developed for the collection of tissue from lobster, finfish (flounder, tautog, bluefish) and channeled whelk to assess the potential bioaccumulation of contaminants in organisms at the existing disposal sites and at non-disposal areas within LIS. The assessment will include analysis for metals, PCBs, pesticides, bis(2-ethylhexyl)phthalate, lipid content, water content, PAHs, dioxins/furans, tributyltin, dioxin-like PCBs, and radiochemistry.

C. High (USACE) readies equipment for deployment. (Feb. 2000)

Physical Oceanography

The EPA and the Corps have initiated the collection and analysis of physical oceanographic data (currents, waves, temperature, salinity, etc.) to evaluate the circulation patterns and degree of water movement in LIS. Existing data, including the National Oceanic and Atmospheric Administration (NOAA) National Ocean Survey (NOS) and the State University of New York (SUNY), Stony Brook and the Disposal Area Monitoring System (DAMOS) data sets from LIS are being reviewed. The review will identify data gaps so that any information needed for the EIS can be collected during the calendar year 2000 field effort.

Fishing Resources and Activities

Fishing resources includes finfish and lobster resources. Fishing activities include commercial and recreational fishing activities. To collect finfish tissue for analyses, we will accompany the Connecticut Department of Environmental Protection (CTDEP) on its planned Spring and Fall 2000 trawl surveys of LIS. Since trawling is avoided in the vicinity of the WLIS site, other sampling methods, including gill nets and hook and line, are planned for that area. We will be collecting lobsters from the Study Areas and conducting tissue analysis.

We plan to interview commercial and recreational fishermen in the Spring and Summer of 2000 to further define the type and amount of fishing effort conducted in LIS including gear used in the Study Areas. These surveys will supplement the aerial surveys of lobster pot buoys. The aerial surveys will be taken during the peak season.

Schedule

Since the October 1999 workshops, a field work schedule has been developed, protocols drafted and refined along with the associated laboratory analyses. The field work for the open water disposal alternative has been scheduled to take advantage of the LIS resources during peak seasons.

- ***Winter 2000*** - Sediment sampling (completed)
- ***Spring 2000*** - Physical oceanographic data, finfish collection
- ***Summer 2000*** - Lobster collection, benthic tissue bioaccumulation/community analysis
- ***Fall 2000*** - Additional physical oceanographic data (if needed) and additional finfish collection

This schedule will complete a full year of data to assist in characterizing LIS.

An update on the status of the field program will be provided at the April 2000 workshops.

J. Brochi (USEPA) extracting sediments from the Ted-Young grab sampler. (Feb. 2000)

For more information, please contact Ann Rodney, US EPA, 1 Congress Street, Suite 1100, CWQ, Boston, MA 02114-2023, 617-918-1538 (tel), 617-918-1505 (fax), rodney.ann@epa.gov (email), or visit our Web Site at www.epa.gov/region01/eco/lisdreg/.

U.S. Army Corps of Engineers, New England District
U.S. Environmental Protection Agency, New England Region

ATTENDANCE RECORD

Name: ______________________________ Telephone: ________________

Address: ____

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Business or Organization(s) you represent: ______________________________

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Please check box(es) at right if you wish to:

- Speak at the Meeting ☐
- Submit Written Statement ☐
- Be Placed on our Mailing List ☐

See Reverse for Privacy Act Statement

NAE FORM 751 4 Aug 97   Supersedes NED Form 751, dated 1 Oct 81.

PRIVACY ACT STATEMENT

Under the provisions of the Federal Privacy Act of 1974 (5 U.S.C. 552a), furnishing the information requested on the reverse side of this card is voluntary. All information provided becomes a part of the public record and, as such, will be available for disclosure to the general public. Information requested on this card is used to compile a record of attendance and to provide a mailing list for the purpose of sending further information on this project, if required.

US Army Corps
of Engineers
New England District

United States
Environmental
Protection Agency
Region I

Workshop Evaluation

Which workshop(s) did you attend?

☐ 4/11/00 in Port Jefferson, NY ☐ 4/12/00 in Groton, CT

1. Overall, did you find the workshop(s) beneficial? If not, why?

2. Do you feel that there was sufficient time to adequately discuss the topics?

3. Were the questions that were provided for each topic expressed in a clear manner?

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4. Do you have any suggestions for future workshops?

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5. Please rate the facilitators:

_____ Excellent _____ Good _____ Fair _____ Poor

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Thank you for completing this form. Please send any comments to:

U.S. EPA - New England Region
ATTN: Ann Rodney
One Congress Street, Suite 1100, CWQ
Boston, MA 02114-2023

or by e-mail to: rodney.ann@epa.gov

April 2000

United States Environmental Protection Agency

US Army Corps of Engineers
New England District

LONG ISLAND SOUND DREDGED MATERIAL DISPOSAL EIS

Description of Disposal Alternatives

The following has been excerpted from a report prepared by Science Applications International Corporation (SAIC) for the State of Connecticut, Department of Environmental Protection, Office of Long Island Sound Programs, Dredged Sediment Management Study. The report is Carey, D.A. 1998. *Long Island Sound Dredged Material Management Approach. A Study Report prepared for State of Connecticut, Department of Environmental Protection, Office of Long Island Sound Programs, Hartford, CT.* 189p. This excerpt presents a list of potential alternatives to open-water disposal of dredged material in Long Island Sound (LIS), and describes in general terms the alternatives available.

Introduction

To maintain safe use of Long Island Sound's waterways and berthing areas by the wide variety of vessels that ply those waters, up to a million cubic yards (cy) of sediment is dredged from harbors, marinas, and navigation channels around Long Island Sound each year. Existing procedures for evaluation of disposal alternatives consider three management options: open-water disposal, confined disposal (aquatic or upland), and beneficial use. The majority of sediments dredged from the coastal areas of Long Island Sound are disposed at four open-water sites: WLIS, CLIS, CSDS and NLDS. Here sediments are released from bottom-opening hopper dredges or barges at selected locations within each site. Confined disposal may involve placement of material in diked nearshore facilities or in upland confined disposal facilities (such as landfills), but such options are rare for Long Island Sound. Existing confined disposal activity within Long Island Sound has mainly involved careful placement of dredged sediments in mounds at the open-water disposal sites; the mounds are then covered, or capped, with clean dredged sediments. Beneficial use involves the use of dredged material for productive purposes such as beach nourishment, landfill cover, wetland creation, or island creation.

This alternatives analysis section provides a review of existing technologies and approaches to treatment or disposal dredged material from Long Island Sound.

The purpose of this review is to provide current information on alternatives to open-water disposal of dredged material that are applicable for sediments dredged from harbors and navigational channels in Long Island Sound. Towards this end, it is important to place this review in the context of dredged material, because many of the alternatives were developed for relatively low volumes of highly contaminated soils or sediments from land-based or freshwater sites. An overview of the nature of marine sediments, therefore, is important to understand the limitations and benefits of the alternatives summarized in this document. In general, characteristics of sediment dredged from LIS harbors include

- wide range of sediment volumes (from 1,000 cubic yards [cy] to >500,000 cy);
- large variation in dredging and disposal needs (no dredging conducted June-September, approximate ten-year interval between large federal navigation projects);
- complex chemical mixtures, commonly nonvolatile and relatively insoluble, and low to medium concentrations of metals, PAHs, and PCBs;
- completely saturated with saline or brackish water, resulting in sediments with very high water content, depending on the type of dredging;
- patchy distribution of contaminants ("hot spots") and grain sizes;
- potential presence of errant material (e.g., construction debris, industrial materials, urban refuse);
- wide range of physical properties, from fluid mud in active navigational channels, to highly consolidated marine and lake clays in new navigational channels (projects dredged into ambient or native sediments);
- predominance of silt and clay sized particles (the exception is ha bors along the north shore of Long Island).

Although the alternatives presented here must be evaluated in this context, it is equally important that viable alternatives are considered without bias based on previous experience. Technology for containment, remediation, treatment, and recycling of contaminated sediments is rapidly expanding, and therefore an analysis of alternatives must always be included as part of the evaluation process. *The ultimate goal of this review, therefore, is to identify and evaluate viable solutions for alternatives to open-water disposal, without encouraging diversion of significant limited resources on solutions that are unnecessary or impractical for dredged material of relatively low environmental risk.*

This review of alternatives to open-water disposal of dredged material in LIS relied on extensive, existing literature on the subject of remediation of contaminated sediments (Averett and Francingues 1994, EPA 1994, NRC 1997, Stern et al. 1994, USACE and Massport 1995).

Because broad efforts to collect vendor information have been conducted by several groups in recent years (EPA 1994, USACE and Massport 1995, NRC 1997, MCZM 1997) no attempt was made to independently collect new data. Rather, the objective was to condense the available information and provide specific analyses of the applicability to Long Island Sound conditions. This section should serve as a guide to the available literature, but also stand alone as a summary of existing information. The intended audiences are the regulators, scientists, waterfront and harbor commissions, advocacy groups, and resource users (permit applicants, dredgers, waterfront businesses, recreational users) that must grapple with decisions about dredged material management in Long Island Sound.

Organization of the Review

The review is organized to first provide descriptive details on the alternative choices as a reference for users of the document, and then to summarize the information in a format that is useful to those making decisions about dredged material management. A list of the included alternatives is provided below followed by a full description of each alternative to disposal for contaminated material (Treatment Alternatives, Containment Alternatives, and Beneficial Use Alternatives).

While each alternative is presented here individually, it is generally acknowledged (EPA 1993b, NRC 1997) that many approaches for handling contaminated sediments must be combined to be effective. The concept is referred to as a "treatment train," which refers to the notion that dredged material may pass through several handling and treatment steps before it is suitable for disposal. An example would be to inject a chelator into a hydraulically dredged sediment to bind metals, wash the sediment to remove relatively clean sand and metals, precipitate the metals from the washwater, and compost the remaining silt to degrade organic contaminants before use in a confined disposal facility. There are almost endless possible combinations of treatment and disposal options, but the concept of a treatment train reinforces the awareness that a single all-purpose alternative is not likely to be available for all sediments in LIS.

List of Alternatives to Open-Water Disposal

When proposed dredging projects are under consideration, one of the first issues that permittees or federal agencies must address is the eventual fate of the material dredged during the project. Initial evaluation of the site, volumes, and recent history of the area may give an indication of the suitability of the materials for disposal. Each project must consider a range of alternatives for the disposal of dredged material. The list that follows is a general listing of alternatives that could be evaluated in New England (Table 1). The list is organized first into groups that reflect whether the materials are determined to be unacceptable for unconfined open-water disposal due to contaminant levels or suitable for open-water disposal. If materials are unacceptable for open-water disposal the materials can be treated or contained (or both, see treatment train above). If materials are suitable for open-water disposal they can be evaluated for beneficial use. Within each of these major groups, the potential processes are arranged roughly by increasing complexity or cost. One general name was elected for each process, and other names are indicated in parentheses. The glossary provides a standardized terminology for processes and the terms used in this document.

Treatment alternatives follow four basic strategies: separation; reduction; stabilization; or destruction. Separation strategies are designed to remove the contaminants from the sediments for further treatment or confinement. Reduction strategies are designed to remove the uncontaminated fraction of the sediments to reduce the volume that must be treated or contained. Stabilization strategies seek to fix the contaminants into the sediment matrix to reduce the possibility of exchange with the ecosystem. Destruction strategies are based on the goal of destroying the contaminants to render them harmless. The list has been organized by the nature of the processes involved (biological, chemical, thermal), but these processes generally follow one of these strategies.

All treatment alternatives rely on some process that disturbs the sediment. One result of this disturbance is the generation of sidestreams, materials that are generated during the process and residuals, materials that remain after the process is complete. Requirements for sidestream treatment and residual management are often significant components of the assessment of the suitability and feasibility of any alternative. These requirements may be underestimated or trivialized in initial evaluations of new technologies, but can become critical when processes are scaled up to treat large volumes of sediments.

Containment alternatives follow one basic strategy: isolate the contaminated sediments to virtually eliminate the possibility of exchange with the ecosystem. The alternatives represent different engineering solutions to this basic strategy grouped by the geographical location of the containment alternative.

For sediments deemed suitable for open-water disposal there are several potential beneficial use alternatives that must be considered. Beneficial use represents an opportunity to provide added value to the disposal of dredged material through engineered enhancement of

Table 1 Alternatives to Open-Water Disposal of Dredged Material in LIS

- Treatment/Decontamination
  - Pretreatment
    - Solids-Water separation (Dewatering)
    - Slurry injection
    - Physical separation (Particle classification, Soil washing)
- Biological Treatment (Bioremediation)
    - Land treatment
    - Composting (Manufactured soil)
    - Bioslurry reactors
- Immobilization
    - Stabilization
    - Solidification
- Chemical Separation
    - Solvent extraction
    - Metal leaching (chelation)
- Chemical Treatment
    - Dechlorination (dehalogenation)
    - Oxidation
- Thermal
    - Incineration: Conventional, Innovative
    - Pyrolysis ("burning" without oxygen)
    - Vitrification (fused into glass)
    - High pressure oxidation
    - Thermal desorption
    - Blended cement production
- Containment
  - Confined Disposal Facilities (CDF)
    - Upland CDFs (Brownfields)
    - Secure landfills
    - Nearshore or in-water CDF
  - Confined Aquatic Disposal (CAD)
    - Level bottom capping
    - Borrow pits
    - Geotextile bags with capping

- Beneficial Use
    - Beach nourishment
    - Landfill cover
    - Habitat restoration

coastal habitats, or use in providing isolation of materials that must be contained.

Description of Alternatives

Description of Treatment Alternatives

In the general sediment remediation literature, treatment of material that is removed from the site is termed "ex-situ treatment," recognizing, in a remediation context, that these sediments must be removed for appropriate treatment. Because material requiring dredging (for navigation or port/marina development) cannot be left in place, these ex-situ treatment technologies are the only appropriate treatments. General reviews of treatment technologies by Averett and Francingues (1994) and NRC (1997) are useful sources.

Because dredged material in LIS commonly contains multiple contaminants, a combination of treatments is usually required. This concept, termed a "treatment train" (EPA 1993, NRC 1997), is important when evaluating individual alternatives below. One important consideration of the treatment train approach is that any management plan must include proper controls on all waste streams including liquid and gaseous releases, solids, solvents, and other concentrated residuals.

Pretreatment

Most dredging projects in LIS that might be candidates for treatment technologies contain large volumes of complex mixtures of solids with high seawater content and multiple inorganic and organic contaminants. The first consideration is the large volume of water entrained during the dredging process, which is variable according to the type and specifics of dredging operations, as well as the nature of the sediment themselves (i.e., fine-grained or coarse-grained). For example, most LIS sediments are dredged mechanically, which results in less water content than hydraulic dredging which essentially fluidizes the material. The use of an environmental closed-clamshell bucket, however, increases the amount of water that is transported to the dredging barge. The second consideration is the high salt content of marine sediments that may affect some processes.

The treatment train usually involves a lower energy pretreatment process to reduce the volume, or improve the quality, of the material prior to using more energy-intensive treatment processes. Some of these initial treatments may be sufficient in specific circumstances to permit use of the residual material for landfill cover or other beneficial uses. Pretreatment technologies include dewatering, slurry injection, and physical separation approaches; these technologies are primarily applicable to hydraulically dredged sediment (Averett et al. 1990). LIS sediments are rarely dredged hydraulically (except for beach nourishment), particularly in Connecticut due to concerns for water quality at dredging sites because of a lack of suitable upland containment sites to allow for adequate clarification of the dredged slurry. It is possible that some unknown combination of an environmentally safe hydraulic dredge and alternative treatment technology could be used in the future to permit effective application of pretreatment approaches to LIS sediments.

Solids-Water Separation (Dewatering). Almost all treatments require reduction in the quantity of water in the dredged material. Most dredged materials are dewatered in settling ponds or confined disposal facilities (CDFs) where passive techniques (seepage, consolidation, evaporation) can be augmented with active dewatering techniques (crust management, drainage). This approach to dewatering is cost-effective, but requires large land areas and can be (e.g., with finer grained sediments) very slow (USACE 1987, Palermo and Miller 1995). New England is particularly ill-suited to passive dewatering due to a moist cold climate with fine-grained dredged material. Most industrial treatment technologies require more active processes. These include belt filter pressing, chamber filtration, centrifugation, gravity thickening, addition of thickeners. The industrial approaches can reduce dewatering time, but are problematic for sediments containing silt- and clay-sized particles (EPA 1993b, Stern et al. 1994).

Slurry Injection. Slurry injection is only applied to hydraulically dredged sediments and may have several goals. The primary advantage is a savings in material handling cost and time by introducing pretreatment materials into the sediment-water slurry created during hydraulic dredging (EPA 1991). Chemicals injected into the slurry can promote settling of suspended fine particles through coagulation or flocculation. This finer component of the dredged material may have the highest concentrations of contaminants and thus be the most important to remove from any water generated by the treatment train. Nutrients or microbes can also be introduced into the slurry to promote biodegradation (see bioremediation below). In this case, slurry injection is simply the process for mixing these components into the dredged material.

Physical Separation (Particle Classification, Soil Washing). An important pretreatment approach is the separation of the solid components of the dredged material. This is usually accomplished by physically separating by size (using density, size, or surface properties). The rationale is that most contaminants are tightly bound to fine-grained sediment particles, and separating coarser sediments can significantly reduce the volume requiring treatment. Many dredged materials also contain mixtures of relatively unpredictable large particles (wood chips, shopping carts, and electric cables) that can play havoc with industrial treatment processes.

Particle classification can be accomplished with soil washing techniques that physically separate materials using hydraulic forces (Galloway and Snitz 1994 and EPA 1994) or with dewatered materials through the use of dry screens and shaking tables. These techniques were developed originally by the mining industry to separate ores and minerals from crushed rock and sand deposits. They can be highly effective but require at least 25% sand to be cost-effective (NRC 1997).

One of the most effective uses of soil washing is to reduce the space required in a confined disposal facility. This approach has been demonstrated in CDFs in Michigan and Minnesota where relatively clean sand was separated from more highly contaminated materials (NRC 1997). The most problematic marine deposits around LIS requiring dredging generally contain sand concentrations below 5%. These materials do not lend themselves to cost-effective volume reduction through soil washing. One exception might be some harbors on the north shore of Long Island with very local sources of contamination and high sand concentrations.

Physical separation techniques include the following: grizzlies (used to remove large particles), hydrosizers, hydrocyclones, screens, trommels, spiral classifiers, shaking tables, flotation, magnetic separation, electrostatic separation (Averett and Francigues 1994). Studies of other treatment processes have shown that some physical separation of large particles is essential to protect the machinery used to treat the sediments. In general the goal of physical separation is to concentrate the contaminated sediments into smaller volumes with more uniform characteristics to permit efficient treatment. The large residual volumes of slightly contaminated sediments must still be tested for suitability and disposed in a controlled fashion.

Biological Treatment (Bioremediation)

Bioremediation. Bioremediation is applicable to sediments with contaminants that are biologically available and subject to degradation through organic processes (generally driven by microorganisms, e.g., bacteria and fungi). The goal with this type of treatment is to biologically degrade organic compounds to non-toxic end products. This approach has been used with success in freshwater systems and tested at the bench-scale for marine sediments. Heavy metals can inhibit biodegradation and are generally not detoxified by the processes described here. Some pretreatment to extract heavy metals may be necessary where they are present (most urban harbors in LIS).

Bioremediation in its simplest form involves mixing and spreading sediments on farmland and tilling frequently to promote aerobic degradation (land farming or land treatment). This is not a simple solution for sediments that might fall under Resource Conservation and Recovery Act (RCRA) land disposal guidelines which require lined land treatment units with leachate collection systems or RCRA permitted tanks. An approach with these precautions referred to as contained land treatment has been demonstrated in Europe and may be applicable to RCRA projects (EPA 1994). Land treatment can require months to years to reduce contaminant levels (NRC 1997). More complex processes include composting, and the use of bioslurry reactors are generally designed to speed up this process.

Composting. Composting involves adding organic bulking agents (straw, wood chips, sawdust) that adsorb moisture, increase porosity, and provide a source of degradable carbon to fuel microbial degradation (EPA 1994). Nutrients may be added in the form of manure or sewage sludge to further enhance bacterial activity. The compost "pile" may be formed as windrows on land, in barges, or closed vessels. Aerobic conditions appear to be more effective in reducing most organics, thus requiring a supply of oxygen through mixing or turning the piles. However, some compounds (e.g., PCBs) require anaerobic conditions to degrade. The general formula is to mix 90 parts compost with 10 parts dewatered contaminated sediments. Composting is also referred to as manufactured soil production. In this case, sediment is mixed with compost, manure or sludge, and lime and fertilizer to create a viable topsoil for land farming, phytoremediation or, in special circumstances, topsoil for use in restoration of degraded land sites.

Phytoremediation. Phytoremediation refers to planting hardy species on manufactured soil or contaminated sediments to facilitate reduction of contaminants. Plant species are selected for physical effects, extraction, and degradation of contaminants. Physical effects include stabilization of soils, transpiration of volatile compounds, and dewatering (trees such as poplars, cottonwoods, and willows can use 25-200 gallons of water per day). Extraction is primarily effective for metals and involves accumulation of contaminants in roots, translocation to shoots and leaves, and eventual harvesting and treatment to remove metals from the site. Degradation of organic contaminants is enhanced in the root zone through supply of nutrients, aeration, and production of enzymes by certain plants. However, the primary process is extracting contaminants into another medium (plant tissue).

Bioslurry. Bioslurry reactors take the process a step further by introducing a controlled mix of microorganisms, sediments (50% by weight), and additives (oxygen, nutrients, pH controls) into a reactor vessel that is stirred mechanically. The reactor vessel is monitored to maintain temperature and dissolved oxygen levels at optimum levels. This approach has been tested at bench- and pilot-scales with some encouraging results. It is best suited for fine-grained sediments that can be maintained in suspension. Most systems are operated in a batch-mode (material introduced, kept in reactor, removed, new batch introduced) because the process requires 2-12 weeks (EPA 1994).

Natural Recovery. Natural recovery or in-situ biodegradation utilizes indigenous or introduced bacteria to degrade organic compounds in sediments. This concept has generated a high level of interest with the regulatory community because limiting handling of sediments reduces costs and minimizes impact on adjacent environments. It is not specifically applicable to maintenance dredging (because the sediments must be removed for navigation) but questions have been raised whether in-situ treatments could mitigate effects of disposal or prepare harbor sediments for future dredging. EPA and USACE have sponsored significant research efforts in this area, but the current wisdom suggests that bioremediation can be most effectively conducted in engineered treatment systems where environmental conditions can be controlled and adjusted. The primary difficulty is that the most efficient conditions for bioremediation require different conditions for each stage in the process and in-situ treatments have little or no control of any external conditions. The rates and effective end-products of uncontrolled bioremediation are unknown, although research priorities have been identified (NRC 1997). Some remediation projects may evaluate natural recovery as part of a comprehensive Remedial Investigation Feasibility Study (RI/FS) and determine that natural rates of degradation contain acceptable risks (Thornburg and Garbaciak 1997).

Immobilization

Immobilization involves addition of chemical reagents to alter the chemical or physical characteristics of sediments for the purpose of binding contaminants and limiting their mobility. This is achieved through chemical stabilization or solidification (both may occur in some processes).

Stabilization. Chemical stabilization alters the chemical form of the contaminants to make them resistant to leaching and may adsorb or react with free water to form a hydrous compound and a dry material. Other processes may also stabilize contaminants through chemical or thermal conversion (see Chemical Treatment and Thermal Treatment below) and may be combined with solidification to produce usable products.

Solidification. Solidification converts sediments into solid blocks and binds contaminants into a stable matrix, but may not chemically stabilize all contaminants. Solidification imparts physical stability to sediments which can improve handling and engineering properties (improving potential for use as fill or road base).

Chemical reagents used for immobilization include cements (portland cement), pozzolans (volcanic or fly ash), lime, kiln dust, thermoplastics, and asphalt. Many commercial processes include various proprietary compounds to improve stabilization of specific contaminants (EPA 1994). Most processes involve mixing the reagent with sediments in a mixing mill (pug mill) and then handling the products as appropriate (forming blocks, crushing to aggregate size). Immobilization has proven most effective with metal compounds and inorganic contaminants. Organic compounds may be stabilized by entrapment or microencapsulation in the solid matrix, but are generally not good candidates for immobilization processes that do not also involve some thermal pretreatment. The heat generated by the solidification process can release volatile organics, and high levels of organics can interfere with the solidification/stabilization process (EPA 1991).

Chemical Separation

Separation or extraction of contaminants from sediments can also be achieved through addition of a chemical solvent. These processes use solvents to dissolve contaminants that are tightly bound to fine particles and concentrate them in the liquid solvent (or gas). The solvent is then recovered for treatment. Extracted contaminants can be further concentrated, isolated, or destroyed. The primary advantage of this approach is that the volume of material requiring treatment is reduced as much as 20-fold (EPA 1994). Another advantage is that the contaminants are removed from the solids and concentrated in a liquid phase which is more easily treated.

Solvent Extraction. Solvent extraction does not necessarily require dewatering, but does require removal of large particles and debris. The recommended maximum size of particles is 0.5 cm (EPA 1988) but this may vary depending on the scale and type of extraction. To be cost effective, solvents used for extraction must be separated from the contaminants and recycled for use in subsequent extraction cycles. Most processes require repeated cycles to remove contaminants efficiently and are therefore usually processed in a batch mode. This has led to the development of a treatment loop where solvents are vigorously mixed with contaminated sediments in an extractor vessel, separated from the solids into a separator vessel, separated from the water and contaminants, and reintroduced into the extractor vessel for up to four washes before the solids are removed.

Organic compounds have received the most attention as candidates for solvent extraction. The processes involve the use of nonpolar compounds such as hexane, chlorofluorocarbon, triethylamine or pressurized carbon dioxide or propane. Most of these compounds are highly toxic and require efficient removal from the treated sediments prior to disposal. In general, chemical extraction with solvents may be practical for small volumes of sandy sediments that have high concentrations of organic contaminants weakly bound to particles (EPA 1994).

Chelation. Metals can be removed from sediments through the use of leaching solutions of acids, bases, or metal chelators. The remaining sediments must be neutralized after treatment and the metal-bearing liquids can be concentrated through precipitation or ion exchange. Any metals present in sulfide precipitates or bound to fine-grained sediments will not be effectively removed by these processes. Marine sediments are high in sulphide precipitates, but they are not generally considered to be bioavailable. However, most LIS sediments that contain elevated metal concentrations are fine-grained.

Chelation forms a stable complex (a chelate) between metal cations and ligands (chelating agents). It is a form of chemical stabilization and can be used to improve chemical extraction processes (such as soil washing, see above). The stable complex limits reactions between the metals and any other reagents (including organisms) but can increase mobility in water which facilitates removal by washing. Chelation is not effective with organic compounds and has reduced effectiveness with fine-grained sediments.

Chemical Treatment

Chemical treatment refers to the addition of chemical reagents to contaminated sediments to destroy contaminants or convert them to less hazardous forms. Included in this category are dechlorination (dehalogenation), oxidation and reduction. Chemical treatment processes are usually performed in batch reactor vessels (see Chemical Separation above) and may be used as a pretreatment for other processes in a treatment train or serve as the final treatment.

Dechlorination. Dechlorination treatments reduce the toxicity of chlorinated aromatic hydrocarbons (PCBs, dioxins, furans, pentachlorophenol and pesticides) by removing chlorine molecules. All of the processes involve addition of a chemical reagent under alkaline conditions and elevated temperatures (EPA 1994). Chemical reagents are mixed with sediments and heated to 110-340° C in a reactor for several hours to produce the desired reaction. Dechlorination processes are also referred to as dehalogenation and nucleophilic substitution processes, and are effectively limited to liquids or highly dewatered sediments with high concentrations of chlorinated hydrocarbons and few additional contaminants (EPA 1994).

Oxidation. Oxidation processes can reduce toxicity, mobility, and bioavailability of organic contaminants. Oxidation occurs naturally in surface sediments, but the introduction of chemical reagents to transform or break down organic compounds can accelerate this process. During oxidation, electrons are transferred from the organic compound to the reagent usually through binding of oxygen with carbon (the compound is oxidized, the reagent is reduced). This approach is not effective on highly chlorinated organics (see dechlorination above). Advanced oxidation processes have been introduced to treat chlorinated organics through the use of ozone and peroxides in combination with ultrasound and ultraviolet (UV) light. Because of the limited penetration of UV light in slurries, advanced oxidation is not effective with sediments. Most oxidation processes are indiscriminate and any accessible organic compound will compete for oxidizing agents (EPA 1994). Sediments with high natural organic content, such as most LIS harbor sediments, will present a challenge to treatment with oxidation techniques.

Thermal Treatment

Thermal processes utilize heat to destroy, separate, or solidify contaminants in sediments. Because of the requirement of heating wet sediments by several hundreds to thousands of degrees, thermal processes are generally the most expensive. They cannot destroy metals and therefore can require extensive controls on emissions of gases and disposal of residuals (ash or solids). However, for resistant organic compounds such as PCBs and dioxins, they are the most effective methods for destruction. The most promising application of thermal treatment for large volumes of dredged material is in the use of thermal energy to create stabilized solids (cement, glass) that lock in metals after destroying organics. The value of the product may be able to offset the high cost of treatment.

Incineration. Incineration is one of the few treatment technologies familiar to most people. Because of widespread concern over potential stack emissions, incineration facilities routinely face tremendous siting issues. Despite this controversy, incineration is used for a wide variety of industrial and household wastes. Incineration technologies burn organic compounds in the presence of oxygen at temperatures from 650 to 980° C. The process of oxidation increases the leachability of metals in residual ash which may need to be treated as hazardous waste. Incineration has not been widely used for treatment of large volumes of wet sediments because the sediments must be dried and mixed with fuel in order to burn off organic compounds.

Incineration can be accomplished with a variety of conventional approaches. All of these produce a dry ash residue and require secondary combustion chambers (up to 1300° C) and careful control of flue gas emissions (particle capture and gas scrubbing) which generates waste water. Conventional approaches include rotary kilns, fluidized beds, multiple hearths, and infrared hearths. Of these, rotary kilns are the most common and may be combined with other technologies (see blended cement production).

Newer incineration approaches have been developed at a pilot scale that incinerate at higher temperatures for greater destructive efficiency and do not produce ash. The residual product is either a dense slag or glass-like solid that will not leach. These innovative technologies are often referred to as plasma vitrification, but there a variety of approaches. Even the newest technologies require complex emission controls.

Pyrolysis. Pyrolysis destroys organic molecules at high temperatures in the absence of oxygen and has been applied to complex chlorinated organic compounds (PCBs and dioxins) that are resistant to incineration (or create dangerous byproducts). The process decomposes complex organic molecules that are burned as a gas in a secondary combustion chamber. Sediments introduced into the reactor must be well-screened and dewatered. The residual ash or slag does contain metals, but because they are not oxidized they are no more leachable than in the original sediment. Some proprietary processes tested at a pilot scale create a vitrified slag but require sediments with less than 1% moisture content (EPA 1994). Like incineration, stack emission controls and wastewater treatment are required with this process.

High Pressure Oxidation. Two newer technologies use high temperatures and pressure to destroy organic molecules. Wet air oxidation has been applied to wastewater sludge and at the bench scale to sediments contaminated with PAHs and PCBs. The technology was effective with PAHs but did not efficiently destroy PCBs. Supercritical water oxidation has had limited testing, but shows promise for destruction of PCBs. Several advantages of high-pressure oxidation include the ability to use wet sediment and lower projected costs than incineration or pyrolysis. At this time, the available data on supercritical water oxidation is very limited (EPA 1994).

Vitrification. Vitrification refers to new technologies that use electricity to heat sediments above the melting point of silica (>1600° C). The high temperatures destroy organic compounds and melt siliceous minerals. Once cooled, the glassy mineral matrix binds any metals or organic byproducts. The resulting product is a glass-like solid resistant to leaching that can be crushed and used in roadfill, asphalt production, and other uses (glass-fiber). Vitrification must include control of stack emissions of volatile metals and organics and the resultant wastewater (from scrubbers). One difficulty with application of vitrification to large volumes of sediments is that the product can take months to years to cool.

Thermal Desorption. A wide variety of proprietary technologies use the principle of thermal desorption. Thermal desorption technologies heat sediments to release volatile and semivolative compounds. Water, most organic compounds, and volatile metals (e.g., mercury) are driven off as steam and gas at temperatures between 200° and 760° C. Most processes maintain an inert (oxygen-free) atmosphere during the process to limit oxidation of organic compounds and the risk of ignition. The gas stream is treated to remove dust and condensed into water and organic vapor. The organic vapors (which contain most of the contaminants) can be adsorbed on activated carbon filters or burned. This process generally requires less energy than incineration, produces less stack emissions, but requires treatment of the organic vapors and more pretreatment of the sediment. Moreover, the processes are not effective with less volatile organic compounds and metals.

Blended Cement Production. A combination of thermal destruction in a rotary kiln and incorporation of the solid byproducts (ash) into a blended cement product is under evaluation by the NY/NJ Harbor Sediment Decontamination Project. This combination of technologies has the advantage of utilizing existing production facilities (cement manufacturer) and creating a valuable by-product to offset treatment costs. This is distinct from the use of cement for stabilization or solidification in that the sediments are thermally treated first and the by-product of the thermal treatment is used in the production of cement.

Description of Containment Alternatives

Confined Disposal

Confined disposal is the most commonly used alternative for disposal of unacceptably contaminated dredged material from LIS. Where land or aquatic sites are available, it is generally the most cost-effective alternative. Increasingly, land and aquatic disposal sites are becoming less available and more innovative schemes have developed. These include development of in-channel disposal in Boston Harbor, excavation of borrow pits in Newark Bay, and creation of islands and disposal facilities in barren or industrialized land. The primary limitation of all of these approaches is the long-term availability of physical space to contain the dredged materials. Some solutions may be one-time only or project specific and others may only be available under limited geographical conditions.

Upland Confined Disposal Facility (CDF). Upland disposal of contaminated dredged material is frequently considered as an alternative to open-water disposal. In New England available sites are limited, but several regional projects have made use of landfills in Utah (Port Authority of NY/NJ) and upstate New York (Hudson River). Several possibilities can be considered as alternatives in New England: construction of a new confined disposal facility (CDF) to accommodate dredged material; use of brownfield sites on adjacent industrial land (brownfields are land degraded by industrial activity that require remediation); use of existing licensed solid-waste disposal facilities (landfills); or some combination of the above.

Upland CDFs are usually constructed by diking land adjacent to aquatic sites or navigational channels to confine contaminant runoff and/or dewater dredged material (USACE 1989). These facilities are distinguished here from in-water CDFs where berms or bulkheads are constructed adjacent to a shoreline, or as a complete island (see below). The construction of an upland CDF must account for the water content of the sediments either through regulated "return flow" to the watershed or by completely containing the sediments and associated water. A CDF may be constructed with a large cell to hold the bulk of the materials and smaller cells to hold water drained off the dredged material. The CDFs must be lined to prevent loss of water through dikes or into the groundwater. The most effective linings are clay or bentonite-cement slurries (EPA 1991).

Containing contaminants within the CDF is a challenging design requirement. When dredged materials are first introduced to the CDF, they typically have water content greater than 40%, are anaerobic, and of neutral pH (USACE 1987). As the sediments dry and oxidize, contaminants bound to the sediment particles (particularly metals) are mobilized and can leach from the sediments in surface runoff or become more bioavailable. Contaminants can be lost through leachate, seepage through dikes, volatilization to the air, or uptake by plants and animals. These potential pathways of contaminant loss can be controlled through lining and efficient sealing or capping of the CDF; however, they may be present during filling and will require continuous monitoring.

Brownfields are increasingly viewed as potential sites for development of CDFs or disposal of manufactured soil (see above). However, brownfields remediation programs are not geared toward accepting degraded dredged material except under unusual circumstances. Petrovski et al. (1997) in their review of disposal alternatives for Indiana Harbor, IN. distinguished brownfields from grim brownfields and green sites. Brownfields are contaminated sites that are currently unused, usually a legacy of a dismantled industry (refinery, metal plating). Grim brownfields are highly contaminated sites but have not qualified as CERCLA cleanup sites. Green sites are pristine areas with little perceived liability. They suggested that siting CDFs on greensites was nearly impossible and turned their attention to brownfields.

The regional New England office of the EPA has initiated a regional pilot program aimed at helping municipalities redevelop contaminated parcels in their community. Under this program, the EPA is conducting Brownfields Site Assessments at selected sites in New England. The purpose of a Brownfields Site Assessment is to determine the nature and extent of contamination and to estimate the costs of cleaning up the site for redevelopment.

Nearshore and Island CDFs. Like upland CDFs, nearshore and island CDFs are also usually constructed with dikes or bulkheads that extend above the water's surface and isolate the disposed material from the nearshore waters. But they differ from upland CDFs in several important ways. In-water CDFs are still subject to loss of contaminated leachate through dikes but must also contend with potential infiltration from seawater and the erosive action of waves and currents. For these reasons, in-water CDFs are usually armored and designed to conform to coastal engineering principles. This approach requires prediction of oceanographic conditions and worst-case modeling.

The land occupied by a nearshore or island CDF is likely to be state-held land and subject to different regulatory restraints. Both New York and Connecticut policies require separate review for any project that impacts tidal wetlands or removes aquatic resources. The process of bulkheading (sheet piles) or diking and filling has historically transformed acres of natural wetlands to "fast land" and removed these resources from the aquatic ecosystem. In a regulatory sense, these tidelands are considered more valuable from the public interest than artificial "fast land."

Appropriate sites for in-water CDFs are eutrophic, shallow subtidal bottoms or shoals that might support an island CDF, degraded urban sites (berthing slips, contaminated tidal lands), or degraded rural areas that might support development of recreational land or marshes adjacent to water. In 1985, the New England Division of the USACE completed a study of dredged material containment for LIS (USACE 1985). The exhaustive study was authorized in 1977 and, in the process of conducting the study, over 300 potential containment sites in LIS were identified. The sites were screened for technical, environmental, and social factors to reduce the list to the most feasible locations. Throughout the process, public participation was involved in suggesting sites, evaluating proposed sites, and adapting plans to meet local needs and conditions (USACE 1985). Five sites were evaluated in detail as prototype sites with considerable effort in engineering studies and designs: Clinton Harbor was proposed as a marsh creation site; Black Ledge off Groton was proposed as an island creation site for a regional disposal facility; Milford Harbor was proposed as a shoreline extension site for use by a local harbor; Penfield Reef off Black Rock Harbor was proposed as a shoreline extension site for use as a regional disposal site; and Sherwood "Hole" was proposed as a subaqueous borrow pit (see below). In the end the findings concluded that the subaqueous borrow pits could be used cost-effectively but did not recommend any diked containment site. In general the study indicated that development of regional containment facilities was not feasible because of community concerns, land-use conflicts, and regulatory restraints. However, the study did conclude that community-level construction of containment facilities may be feasible on a case-by-case basis.

Confined Aquatic Disposal (CAD)

CADs are distinguished from CDFs by the placement of dredged material underwater into some form of a confined area that minimizes lateral displacement of the dredged material followed by covering with clean material (CDFs are here considered confined engineered structures that are on land or protrude above the water's surface to isolate the dredged material from surrounding waters). Methods include the use of existing depressions, excavation of pits, or construction of berms underwater (EPA 1991). CADs have been used to isolate dredged material and create new habitat through capping with suitable material to restore mudflats, marshes, and sand flats (beneficial uses).

In-Channel Disposal (Boston Harbor). An innovative alternative for contained disposal of dredged material was developed for the Boston Harbor Navigation Improvement and Berth Dredging Project (BHNIP) in a joint effort between the Massachusetts Port Authority (Massport), USACE, New England District, the Massachusetts Executive Office of Environmental Affairs (EOEA), and a "Dredging Advisory Committee" (USACE and Massport 1995). Although the Boston project had been planned for decades, a unique combination of circumstances created the opportunity to explore this alternative (Demos 1997). The project required a combination of maintenance dredging and channel deepening to create a navigation and berthing area within the three major tributaries of Boston Harbor that would be consistent with the 40-foot navigation channels that lead to the harbor (Jackson 1997). The project required disposal of over 1 million cy of silt characterized as unsuitable for unconfined open-ocean disposal. The EPA had provisionally closed the recently designated Massachusetts Bay Disposal Site (MBDS) to disposal of this type of material until the efficacy of capping at that site had been demonstrated (see level-bottom capping below). The construction of the Third Harbor Tunnel (now known as the Ted Williams Tunnel) from Boston to Logan Airport created a "floor" or sill that would prevent dredging below the depth of 40 feet in the future.

The project alternative chosen in the EIR/EIS process was disposal of the unsuitable material in 50 cells excavated below the navigation channel which would then be capped with sand so that the final contours would match the improved navigation channel contours (USACE and Massport 1995). The design of the cells is innovative and may still be modified during the final stages of construction. The intent is that the top of the cells remain below the authorized federal channel depth and that material excavated to form the cells (which is suitable for unconfined open-ocean disposal) be disposed at the MBDS. This creates a series of cells in the bottom of the navigation channel approximately 200 ft x 500 ft and up to 20 ft deep partially filled with dredged material and a sand cover. Two aspects of the project stand out: first, the underlying sediments in Boston Harbor are composed of a stiff blue clay that is presumed to form stable near-vertical walls facilitating construction of the cells; second, the presence of the Ted Williams Tunnel limits any future dredging landward of the tunnel to 40 ft depth. These conditions may not be present in other New England harbors with proposed federal navigation projects.

Concerns about the lack of experience in designing and constructing in-channel disposal cells led the EOEA to negotiate for strong project construction monitoring under the auspices of the CWA 401 Water Quality Certificate (Babb-Brott 1997). While the projected costs for this disposal alternative were \$30/cy, the monitoring requirements and uncertainties about the construction methods may increase the actual cost somewhat (currently estimated at \$36/cy). The federal project began in the fall of 1998, but a small commercial berth dredging project associated with the larger project has been completed (Meader 1997). Early results indicated that the dredged material was successfully placed in the cell, but regarding the placement and distribution of capping material resulted in incomplete coverage (Murray et al. 1998). However, the concept appeared sound and operational adjustments have been made for the second phase of cell construction.

Borrow Pits. Borrow pits are shallow depressions in the seafloor that were created through sand mining, but the term has been loosely extended to natural depressions and pits dug for the express purpose of disposing of dredged materials. Borrow pits are distinguished from level-bottom capping by the use of the depressions to keep the dredged material confined laterally. Most designs keep the level of dredged material in the pits low enough to permit capping and restoration of the natural contours of the seafloor (prior to digging the pit). Borrow pits (and proposed pit excavations) are usually on the margins of navigation channels to permit convenient access for excavation and disposal. However, pits can be sited anywhere that materials are suitable for excavation and where the temporary loss of seafloor habitat is acceptable. Present costs have been estimated between $19 and $40 per cy, depending on the distance required for transport of the dredged material and any construction costs.

Sherwood "Hole" was proposed as a subaqueous borrow pit in the 1985 LIS survey (USACE 1985). In the end the findings concluded that subaqueous borrow pits could be used cost-effectively but recommended that they be considered on a case-by-case basis in relation to proposed dredging projects. As it happens, this particular depression was never used, but management efforts at existing disposal sites have created bowl-shaped depressions to control lateral spread of materials to facilitate capping (see level-bottom capping below).

Level-Bottom Capping

Level-bottom capping is distinguished from CAD disposal by the lack of explicit use of lateral containment structures (whether natural or engineered). Level-bottom capping involves the placement of dredged material deemed unsuitable for unconfined open-ocean disposal into a tight mound on the seafloor (usually through the use of a target buoy) followed by placement of a "cap" of dredged material deemed acceptable for unconfined disposal. The cap is used to isolate the contaminated material from the marine ecosystem. During the placement of the contaminated dredged material in any subaqueous location some contaminated material will remain in suspension (attached to fine sediment particles) and drift away from the disposal site. This impact and the temporary loss of aquatic seafloor habitat are the primary environmental concerns about this form of containment. Capping on level areas of seafloor requires relatively large disposal areas. Capping is currently the most commonly used approach for management of contaminated dredged material disposal in New England. In LIS, capping has been conducted and monitored for approximately 20 years (started in 1979) at the Central Long Island Disposal Site (CLIS), making it the most intensively studied example of level-bottom capping in the world (Fredette et al. 1992). The history and results of the use of capping in LIS have been extensively reviewed (SAIC 1995) and a joint USACE and EPA technical guidance document is in preparation (Palermo et al. in press).
A recent innovation in level-bottom capping creates a CAD-like situation by grouping disposal mounds in rings to create areas that promote lateral confinement of contaminated dredged material for large capping projects (Fredette 1994).

Geotextile Bags with Capping. Another innovative contained disposal approach is to place contaminated sediments in woven permeable synthetic fabrics (geotextiles, geofabrics). The fabric is constructed as a large bag or tube and the dredged material is placed in a barge lined with the fabric or pumped into the tube. When the barge releases the tube or bag, the encased dredged material should fall to the bottom with little or no loss of suspended material. Another advantage is that the dredged material should stay within the bag and not spread on the ocean floor. This aspect of the approach could save money through reduction in volume of capping materials required. Several limited trials of this approach have been attempted. Geofabric containers were used to place contaminated dredged material in a project from Marina del Ray in California (Clausner 1996) and have been used extensively to stabilize dikes and accelerate consolidation of dredged material (Fowler et al. 1995). In June 1996, the New York District and the Port Authority of New York and New Jersey conducted a trial drop of two geofabric bags accompanied by extensive monitoring (SAIC 1996a, b, c). Two fabric bags were filled with about 1700 cy of harbor silts, sewn up in barges and released through the split hull barge (USACE 1996). Both bags failed (split open, spilling some of the sediments inside), one while in the barge and one during release. The results of both trials indicate that this approach, while innovative, has yet to demonstrate that all engineering issues have been resolved.

Description of Beneficial Use Alternatives

In relation to other alternatives described in this section, Beneficial Use includes alternatives that seek to use dredged materials as a resource. The ability to use dredged material in this way is highly desireable but is strongly dependent on the grain size characteristics, organic content and contaminant concentrations of the proposed material (USACE 1987). With some of the treatment alternatives described above, bulk products of the treatment may be able to be used a resource for soil enhancement, landfill cover, structural fill or habitat restoration. With a suitable quality and grain size dredged materials can be used to nourish beaches, provide cap material for aquatic disposal sites or provide aquatic habitat enhancement. In this section, I will consider dredged material that is suitable for unconfined open-water or land disposal (even if it requires treatment to reach that quality). One clear requirement of beneficial use is a significant amount of planning to coordinate dredging with the proposed use (USACE 1987).

The types of beneficial uses can be grouped into three broad categories based on their characteristics (after NJDEP 1997):

1. Use of dredged material with minimal processing
   e.g., beach nourishment)

2. Use of dredged material to support other management alternatives (e.g., capping)
3. Use of dredged material with processing or amendment (e.g., landfill cover, fill)

These categories will be used here and in the feasibility discussion and matrices for clarity.

Minimal Processing

Beach Nourishment. Beach nourishment is conducted extensively on open ocean beaches, and to a lesser extent on beaches in LIS. Sediments are placed on the beach face or in berm just offshore to restore sediment supply to the beach. The most common approaches are to hydraulically pump sand from offshore areas or breachways to beaches or to truck sediment in from inshore or inland sources. Appropriate sediments for this purpose are often difficult or expensive to obtain and the prospect of utilizing dredging projects to support beach nourishment is an attractive prospect to many coastal communities and states. In many cases the need for replenishment of beach sediments led to the creation of so-called "borrow pits" (see above). An additional use of dredged material would be to place the material above the beach for dune construction to provide a buffer to coastal erosion.

Beach nourishment can only be conducted with dredged material which has compatible grain size characteristics with the beach. When the material to be dredged is sand but not directly compatible with the sediments on the beach, dune construction may provide an alternative beneficial use. When using dredged material for beach nourishment, consideration must be given to avoid disturbances to nesting species of rare/threatened/endangered shorebirds. This probably means that there would be a ban on beach nourishment for several months at sites known to be nesting areas for rare/threatened/endangered shorebireds.

Aquatic Habitat Restoration. Through selective relocation of dredged material, marine or freshwater sediments can be placed in such a way to enhance or restore degraded aquatic habitats. The Long Island Sound Habitat Restoration Initiative has established a goal of restoring the ecological functions of habitats degraded or lost through human activity. To accomplish this the partners of the initiative have nominated sites throughout LIS grouped in twelve habitat types. Five of these habitat types are amenable to restoration with dredged material:

· Tidal Wetlands
· Freshwater Wetlands
· Shellfish Reefs
· Submerged Aquatic Vegetation
· Intertidal Flats

Nominated sites will be prioritized through ranking criteria based on the potential ecological value of the degraded site as well as feasibility, local support and availability of funding. Establishing a clear priority of habitat value is important because the use of dredged material is likely in most instances to convert a site from an existing habitat type to a new or restored habitat. For example creating a salt marsh to restore lost wetlands may remove valuable intertidal flats from the LIS system.

A comprehensive approach to aquatic habitat restoration has been proposed that incorporates ecological theory and the concept of adaptive management (USACE 1996). This approach recognizes that ecological response is stochastic and dynamic. Efforts to restore a habitat may create surprising results. Adaptive management is appropriate to apply to restoration projects because a long-term commitment is required for such projects to succeed. The goals and designs of a project may require adjustment based on the ecological response to trial manipulations (a "safe-fail approach). Case studies of aquatic habitat restoration projects that have utilized adaptive management, ecosystem planning and a safe-fail approach to judging success include several that have utilized dredged material (e.g., eelgrass meadows, permanent shallow water habitat, oyster reefs, and subtidal habitat improvement; USACE 1996).

Support of Management Alternatives

Confined Aquatic Disposal (Cap Material). One of the most common beneficial uses of dredged material in Long Island Sound is for isolation of material unsuitable for unconfined open-water disposal. Dredged material used for this purpose must be appropriate for the capping project proposed. In LIS a wide range of grain sizes of dredged material has been used in level-bottom capping projects (SAIC 1994). Suitable material could also be used to cap a Confined Disposal Facility (CDF) or a variety of CAD designs (borrow pits, in-channel disposal).

Processed or Amended Dredged Material

These beneficial uses of dredged material require manipulation of the wet salty sediment to make it suitable for disposal on land. Many of the treatment alternatives described above produce large volumes of dry sediment with low bulk values of contaminants. These treated residuals (or sidestreams depending on the process) ideally can find a home in a project that requires large volumes of fill, soil, or covering material.

Landfill Cover. Solid waste municipal landfills typically purchase soil for "daily cover" (to cover the pile of trash and minimize odor and scavenging) and may require specialized materials to provide a final cap. Dredged material or blends of dredged material and soil can be used in some landfills providing they do not have the potential to contaminate ground water with salt or Contaminants of Concern (COCs). In general fine-grained dredged material is not suitable for daily cover (due to dust, erosion and poor drainage characteristics) but may be processed to be suitable for a portion of the final cover.

Structural Fill. Contaminated soils have been used after remediation or augmentation (with compost or stabilizers) in construction projects. Dredged material requires dewatering and if contains a substantial proportion of fine-grained sediment or contaminants of concern it would have to be blended with coarse sediment or stabilized before it could meet the specifications of most engineering projects. In general this is most likely a beneficial use of the residuals of treatment processes (stabilization, solidification, chelation, thermal treatments) rather than a stand-alone disposal option. Another special case is the use of geotextile bags for containment in diking, berms, and scour protection (Fowler et al. 1995).

Non-Structural Fill. Clean or treated sediments can also be used for fill that does not require engineering specifications for supporting structures or roads. The treatment requirements are much the same as for structural fill, but may not require as much stabilization. Compost may be added to provide bulking or binding or to create a topsoil (see soil manufacturing). Again, it is the rare circumstance where fill would be considered without some treatment (dewatering) and thus non-structural fill is a beneficial use of the residuals of treatment. One exception might be the use of dredged material behind bulkheads or berms in a CDF (see above) although some dewatering may still be required.

Agricultural Use. Dredged materials may have some beneficial use in agricultural applications after treatment or augmentation. The most likely use is with non-food crops (nurseries, turf farms) after treatment to remove salt and augmentation with compost to aerate the product. Harbor sediments generally contain high levels of nutrients of value in agriculture (phosphorous, nitrogen, silicon) and the organic carbon content can support microbial activity. There are difficulties with reduced metals and salts that leach easily once the sediments are placed on land. Like fill options, agricultural use is a beneficial use of residuals from various treatment processes (soil washing, manufactured soil, and stabilization) more than a stand-alone disposal option.

LIS Dredged Material Management Approach References

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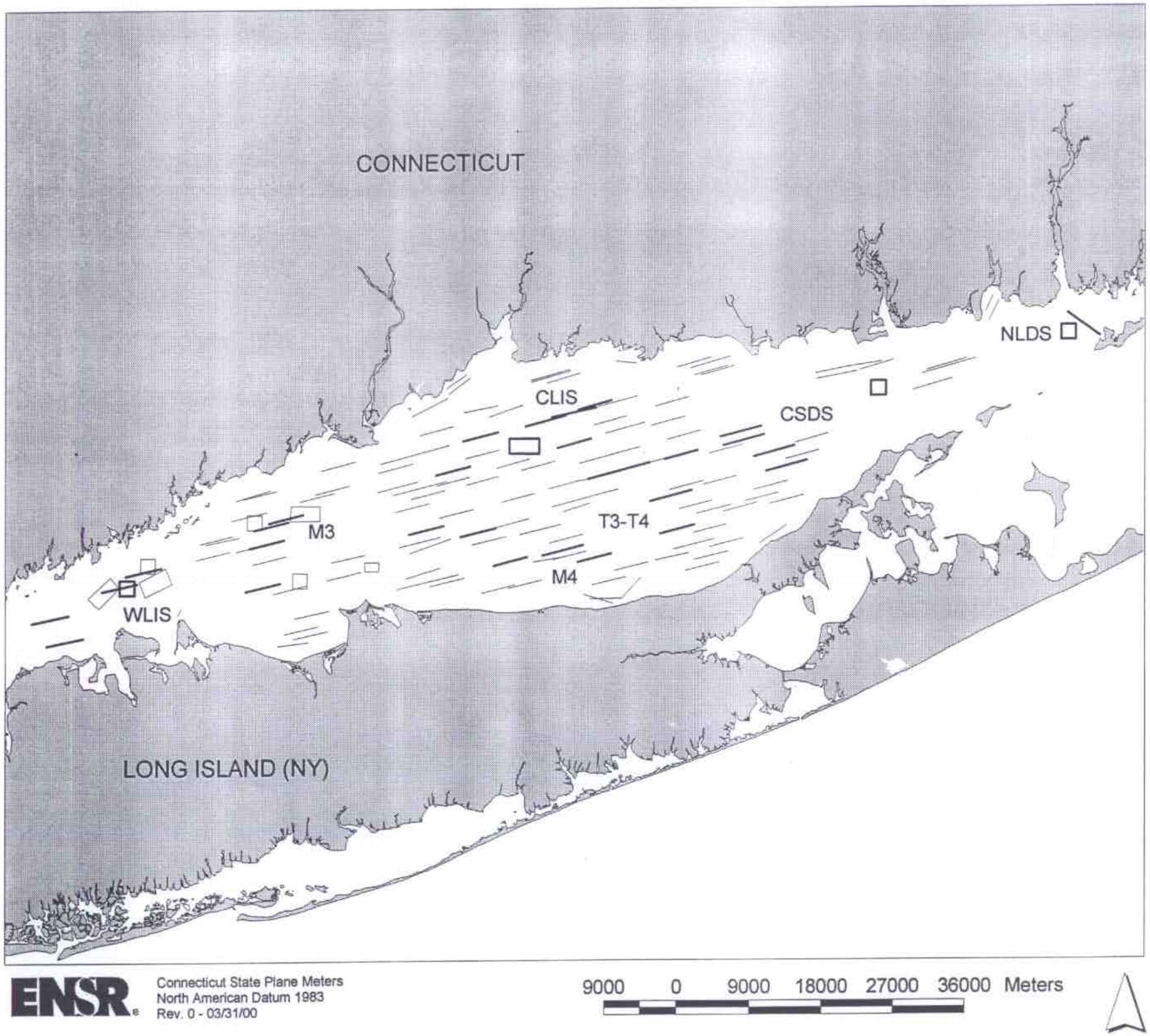
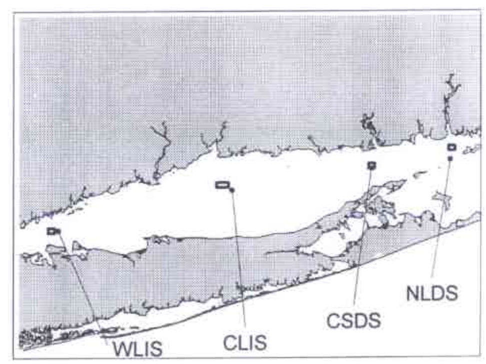




EPA

Long Island Sound Environmental Impact Study

CT-DEP / ENSR
Fish Trawl Sampling Locations

ENSR Fish Tissue Sampling Locations
CT-DEP Additional Sampling Locations
Disposal Sites
Current Disposal Site
Historic Disposal Site

Sources:
Fish Trawl Lines from CT-DEP

ENSR

Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00

EPA

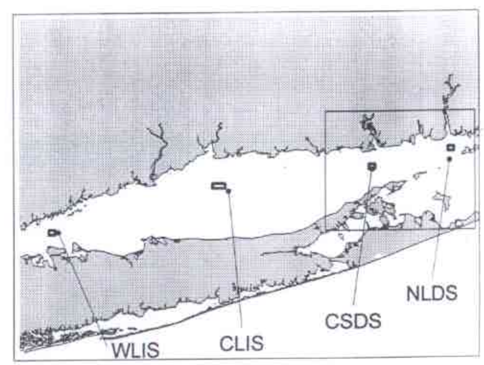
Long Island Sound Environmental Impact Study

ENSR Fish Trawl Sampling Locations
May and September 2000
Eastern Long Island Sound

- - - May 2000
—— September 2000
Disposal Sites
Current Disposal Site
Historic Disposal Site

STRATA:
M2 - Mud 30-60 ft
M3 - Mud 60-90 ft
M4 - Mud +90 ft
T2 - Transition 30-60 ft
T3 - Transition 60-90 ft
S2 - Sand 0-30 ft
S3 - Sand 30-60 ft

Sources:
Fish Trawl Lines from CT-DEP



ENSR

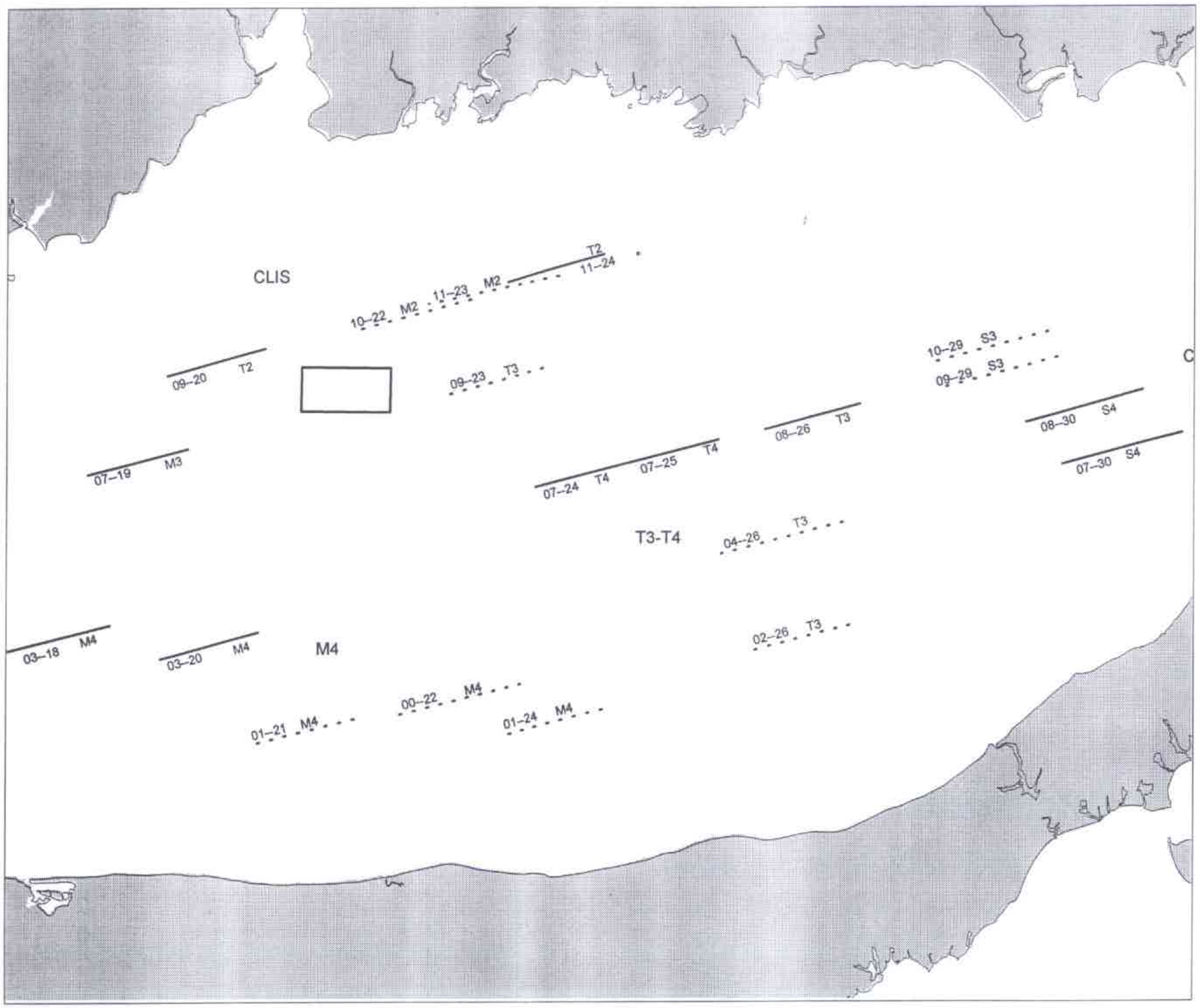
Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00

3000 0 3000 6000 9000 12000 Meters

N

Long Island Sound Environmental Impact Study

ENSR Fish Trawl Sampling Locations May and September 2000 Central Long Island Sound



- - - May 2000
—— September 2000

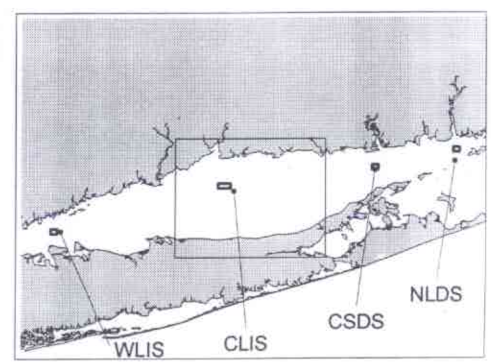
Disposal Sites

Current Disposal Site

Historic Disposal Site

STRATA:
M2 - Mud 30-60 ft
M3 - Mud 60-90 ft
M4 - Mud +90 ft
T2 - Transition 30-60 ft
T3 - Transition 60-90 ft
S2 - Sand 0-30 ft
S3 - Sand 30-60 ft

Sources:
Fish Trawl Lines from CT-DEP



ENSR

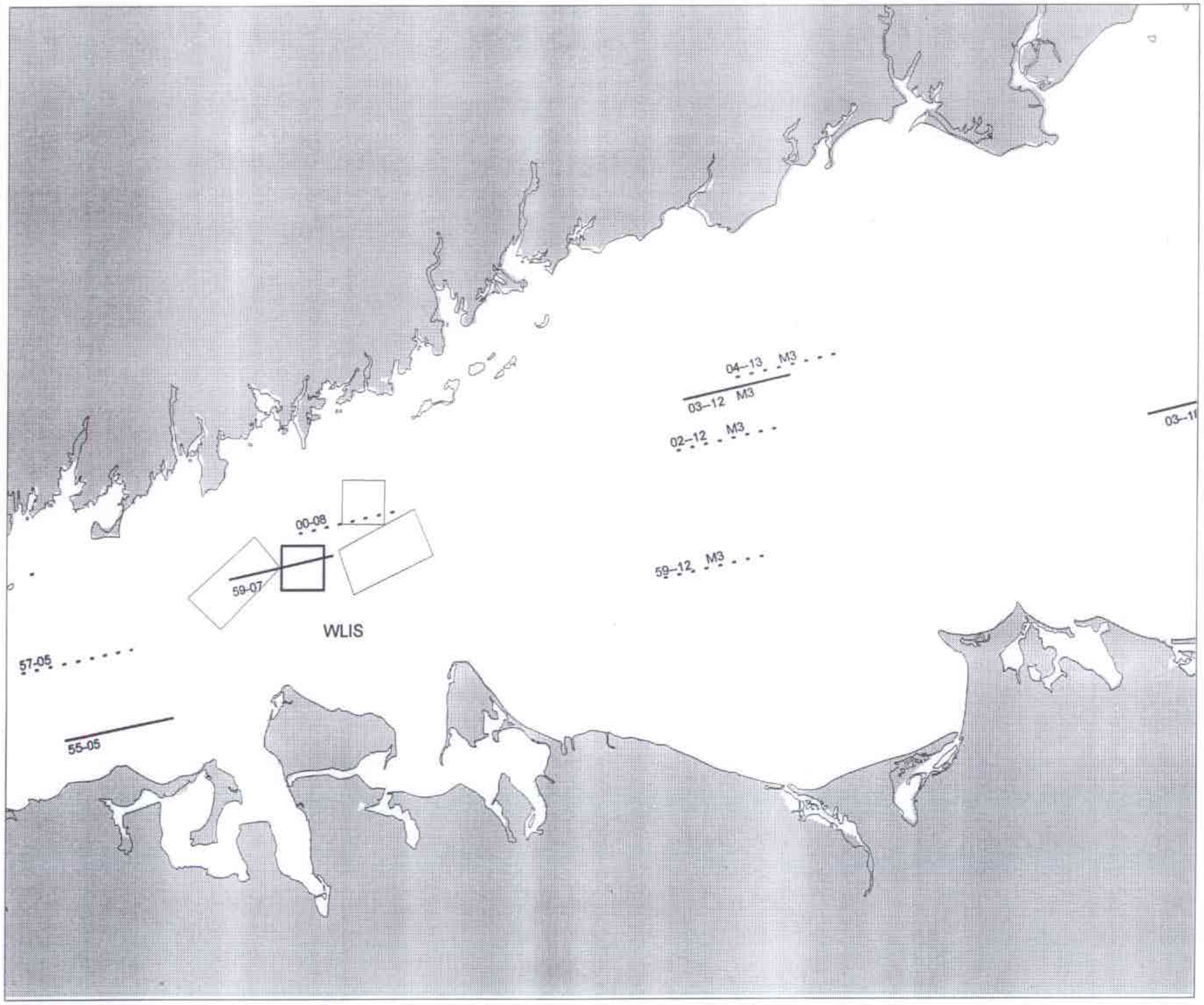
Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00

3000 0 3000 6000 9000 12000 Meters

N

Long Island Sound Environmental Impact Study

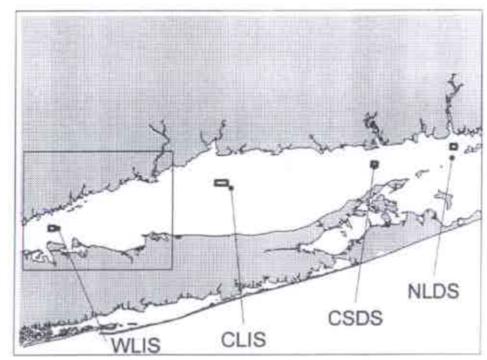
ENSR Fish Trawl Sampling Locations
May and September 2000
Western Long Island Sound



- - - May 2000
—— September 2000
Disposal Sites
Current Disposal Site
Historic Disposal Site

STRATA:
M2 - Mud 30-60 ft
M3 - Mud 60-90 ft
M4 - Mud +90 ft
T2 - Transition 30-60 ft
T3 - Transition 60-90 ft
S2 - Sand 0-30 ft
S3 - Sand 30-60 ft

Sources:
Fish Trawl Lines from CT-DEP



ENSR

Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00

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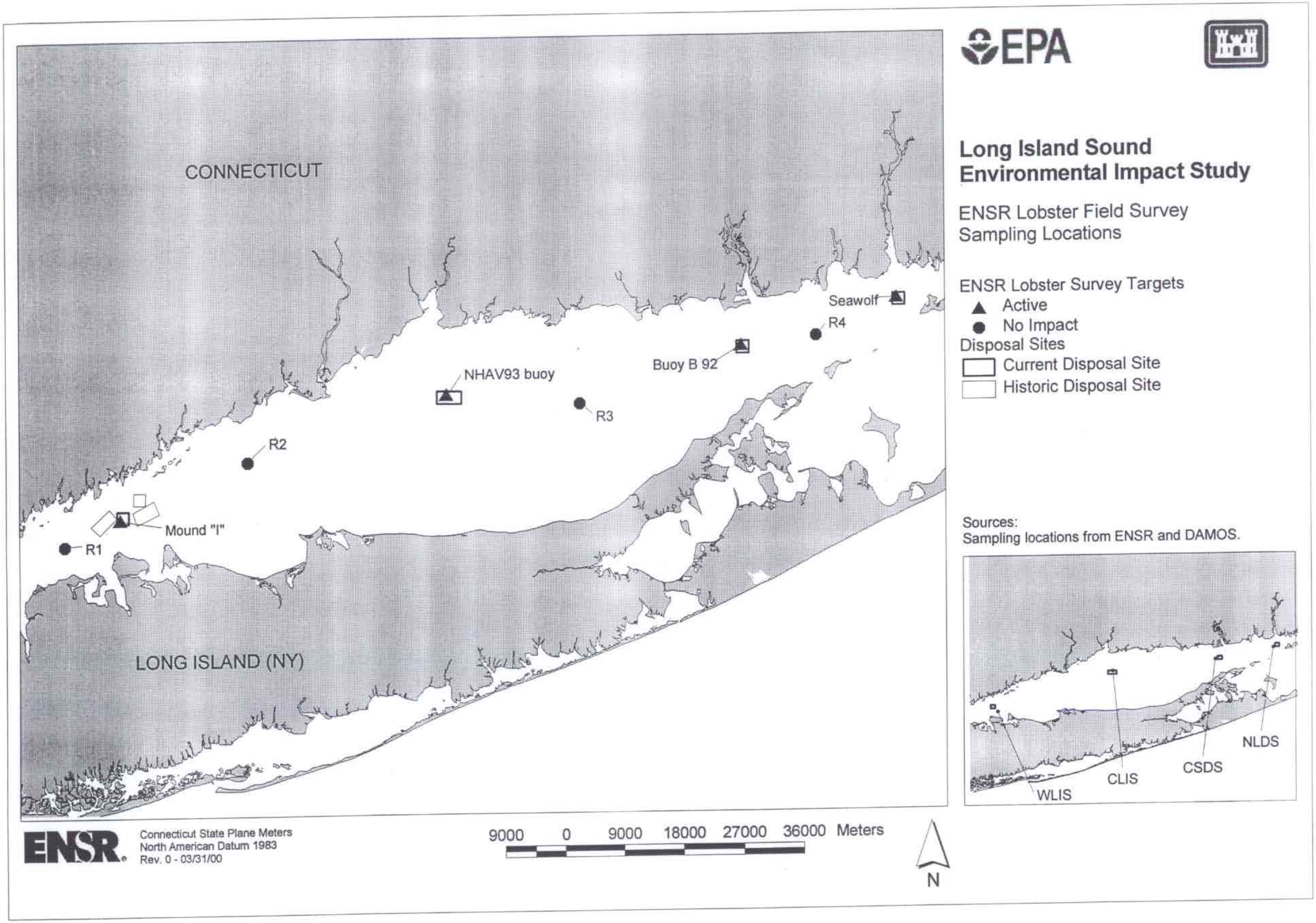
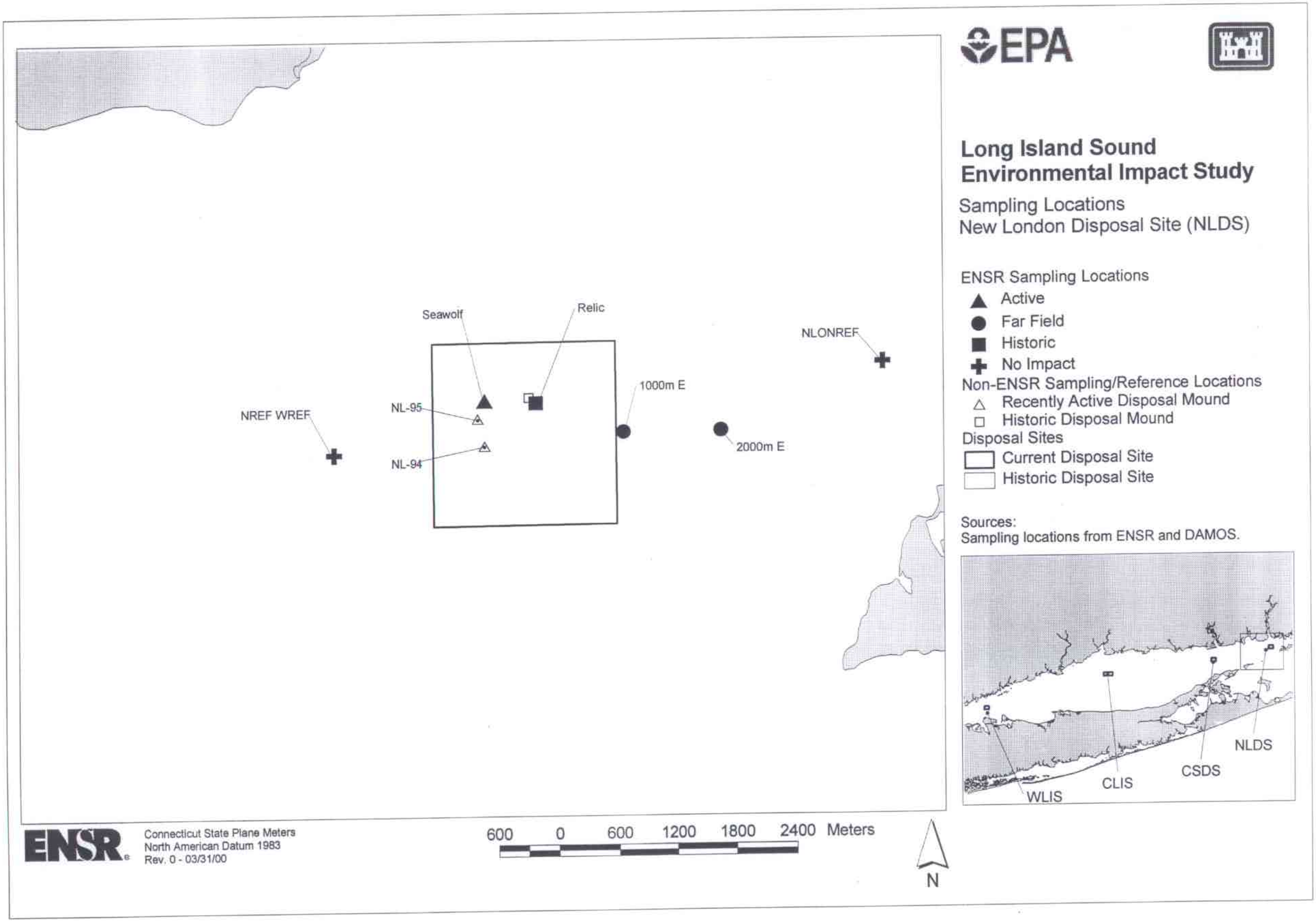
N



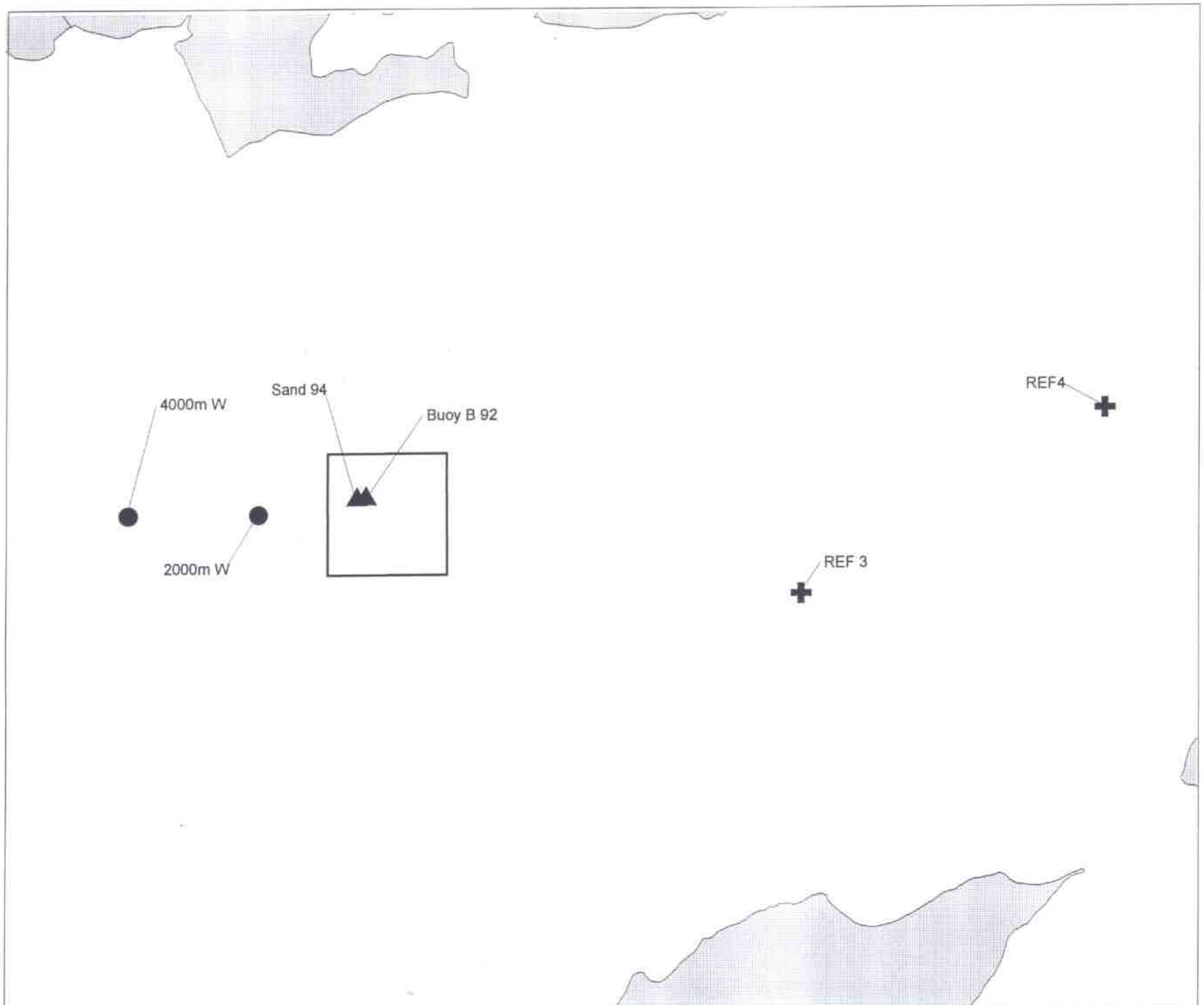
EPA
Long Island Sound Environmental Impact Study
ENSR Lobster Field Survey Sampling Locations
ENSR Lobster Survey Targets
Active
No Impact
Disposal Sites
Current Disposal Site
Historic Disposal Site
Sources:
Sampling locations from ENSR and DAMOS.
CONNECTICUT
LONG ISLAND (NY)
Seawolf
R4
Buoy B 92
NHAV93 buoy
R3
R2
Mound "I"
R1
WLIS
CLIS
CSDS
NLDS
ENSR
Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00
9000 0 9000 18000 27000 36000 Meters
N


Seawolf
Relic
NLONREF
1000m E
NREF WREF
NL-95
NL-94
2000m E
EPA
Long Island Sound
Environmental Impact Study
Sampling Locations
New London Disposal Site (NLDS)
ENSR Sampling Locations
Active
Far Field
Historic
No Impact
Non-ENSR Sampling/Reference Locations
Recently Active Disposal Mound
Historic Disposal Mound
Disposal Sites
Current Disposal Site
Historic Disposal Site
Sources:
Sampling locations from ENSR and DAMOS.
NLDS
CSDS
CLIS
WLIS
ENSR
Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00
600 0 600 1200 1800 2400 Meters
N

EPA

Long Island Sound Environmental Impact Study

Sampling Locations
Cornfield Shoal Disposal Site (CSDS)

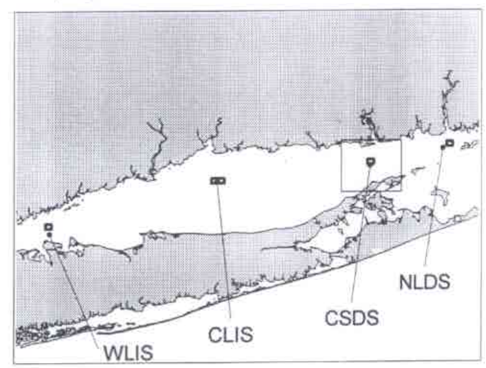


ENSR Sampling Locations
- ▲ Active
- ● Far Field
- ■ Historic
- ✚ No Impact

Non-ENSR Sampling/Reference Locations
- △ Recently Active Disposal Mound
- □ Historic Disposal Mound

Disposal Sites
- Current Disposal Site
- Historic Disposal Site

Sources:
Sampling locations from ENSR and DAMOS.

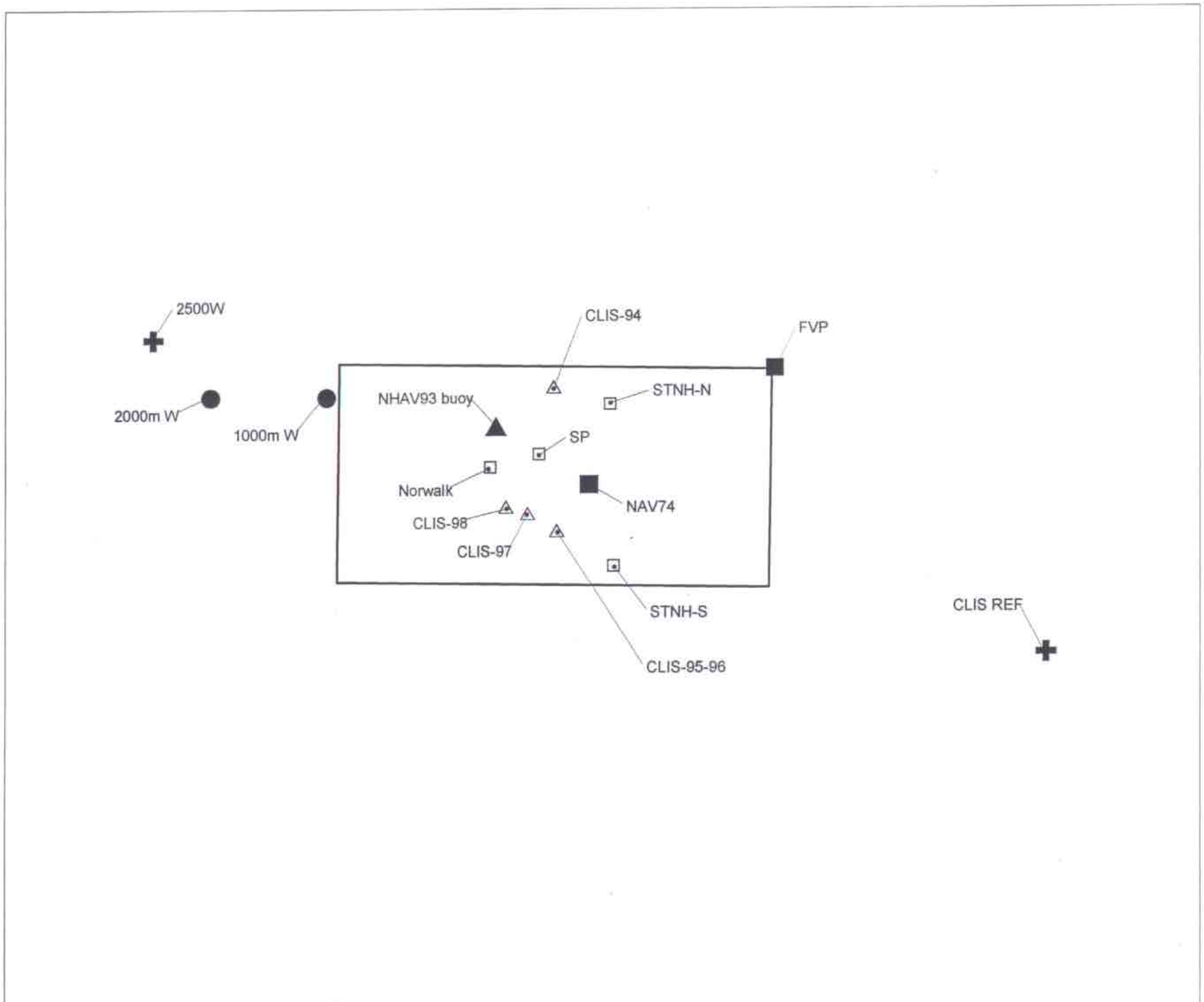


ENSR

Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00

1000 0 1000 2000 3000 4000 Meters

N



Long Island Sound Environmental Impact Study

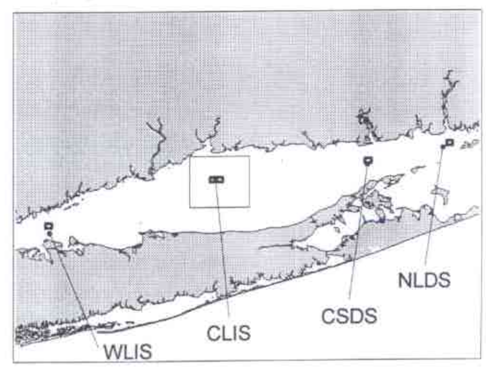
Sampling Locations
Central Long Island Sound (CLIS)

ENSR Sampling Locations
- Active
- Far Field
- Historic
- No Impact

Non-ENSR Sampling/Reference Locations
- Recently Active Disposal Mound
- Historic Disposal Mound

Disposal Sites
- Current Disposal Site
- Historic Disposal Site

Sources:
Sampling locations from ENSR and DAMOS.

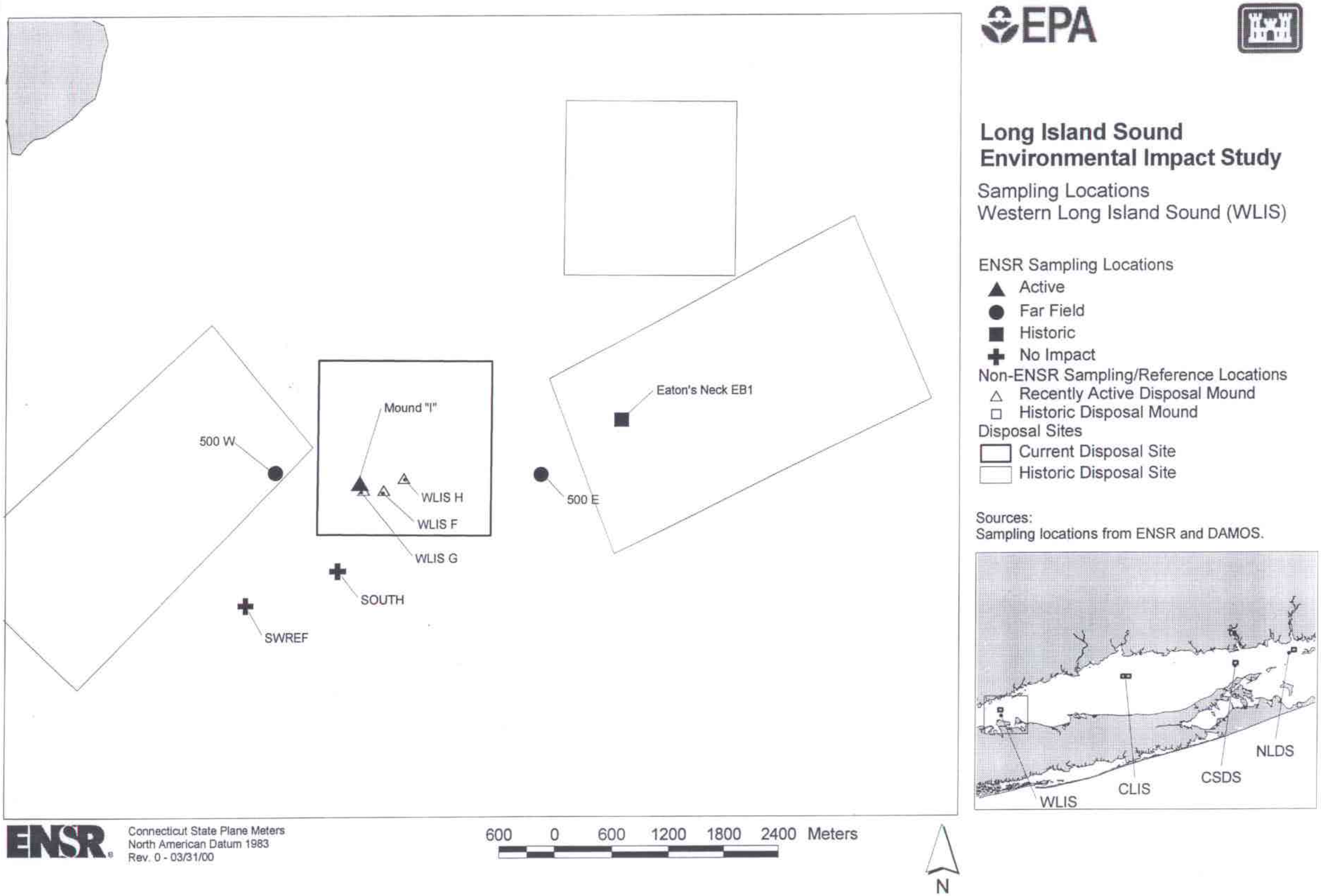


ENSR

Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00

600 0 600 1200 1800 2400 Meters

N



EPA

Long Island Sound Environmental Impact Study

Sampling Locations
Western Long Island Sound (WLIS)

ENSR Sampling Locations
- Active
- Far Field
- Historic
- No Impact

Non-ENSR Sampling/Reference Locations
- Recently Active Disposal Mound
- Historic Disposal Mound

Disposal Sites
- Current Disposal Site
- Historic Disposal Site

Sources:
Sampling locations from ENSR and DAMOS.

ENSR

Connecticut State Plane Meters
North American Datum 1983
Rev. 0 - 03/31/00

United States
Environmental
Protection Agency

Evaluation Factors - April 2000

US Army Corps
of Engineers
New England District

LONG ISLAND SOUND DREDGED MATERIAL DISPOSAL EIS

BALLOT

☐ *Please review the following documents:*

- *Fact Sheet # 1 April 2000: Evaluation of Disposal Alternatives*
- *Description of Disposal Alternatives*

☐ *Using the enclosed ballot or additional pages, please respond to the following questions for as many factors as you can:*

- *Is this factor appropriate for screening and evaluating disposal alternatives?*
- *Does the scoring technique capture the impact of the factor?*
- *What metric value would you use to screen out a site for each factor?*

☐ *Mail the ballot by May 8, 2000 to:*

Ann Rodney
US EPA
1 Congress Street, Suite 1100, CWQ
Boston, MA 02114-2023
(617) 918-1538 (Phone) or (617) 918-1505 (Fax)

EVALUATION APPROACH FOR OPEN WATER SITES (#1)
Working Draft - April 2000

Evaluation Factor	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
I. Open Water					
1. Threatened and Endangered Species a. Federally Listed Threatened or Endangered Species b. States Listed Rare/Endangered Species or those of State Concern	For both categories assess • Presence – Absence • Relevant species description, range, and migratory patterns • Distance from site	U, H, M, L,0			
2. Archaeological Resource Sites	Presence - Absence, distance from site, expected degree of disturbance	H, M, L, 0			
3. Designated Conservation Areas a. Federally designated Marine Sanctuaries, Wildlife Refuges, National Seashores & Parks b. State designated Marine Sanctuaries & Preserves or Fish Havens	For both categories assess • Presence – Absence • Distance and downcurrent effect • Relevant species description and range	U, H, M, L, 0			
4. Navigation Considerations a. Marine Shipping/Transit Lanes b. Anchorage Areas & Harbors of Refuge c. Aids to Navigation d. Recreational Navigation	Draft + propwash + buffer = minimum depth Presence – Absence Presence – Absence Draft + propwash + buffer = minimum depth	Min. depth feet U, 0 U, 0 (1500 ft) Min. depth feet			
5. Existing Habitat Types a. Mudflats and Sandflats b. Spawning/Nursery Habitat c. Submerged Aquatic Vegetation d. Fisheries Feeding/Migration Habitat e. Benthic Habitat (i.e. unique, hard bottom, mussel, complex habitats)	Distance, current direction Distance, current direction Distance, current direction specific species info Presence-Absence – descriptive categories of habitats to avoid (unique features)	H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L U, H, M, L, 0			

EVALUATION APPROACH FOR OPEN WATER SITES (#1)
Working Draft - April 2000

Evaluation Factor	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
6. Commercial and Recreational Fisheries a. Commercial Fisheries Harvest Areas b. Shellfish Propagation and Harvest Areas c. Aquaculture Sites d. Recreational Fisheries Areas	Distance, current direction, amount, type, value Distance, current direction, amount, type, value Distance, current direction, amount, type, value Distance, current direction, amount, type, value	H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L, 0			
7. Site Characteristics a. Physical Area b. Site Capacity c. Current Patterns, Water Circulation d. Exposure to Storm Events e. Ambient Sediment Conditions/Type f. Bathymetry	Size of site (square footage) Capacity of site (cubic yards) Ranges of near-bottom current velocity, potential for change Wave climate Categories: depositional, reworking, erosive Depth	Minimum size Minimum capacity U, H, M, L, 0 U, H, M, L, 0 H, M, L, 0 H, M, L, 0			
8. Site Accessibility a. Route b. Location c. Logistics	Transportation conflicts Distance from site Utilities, etc.	H, M, L, 0 H, M, L, 0 H, M, L, 0			
9. Site Use Conflicts a. Military Practice, Research or Restricted Areas b. Extractable Resource Present c. Utilities (Submarine Pipelines and Cables) d. Public Beaches and Parklands e. Other Commercial Uses f. Recreational Uses	All categories assess • Presence – Absence • Distance from site • Aesthetics • Timing of disposal • Zoning	U, H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L, 0			
10. Duration of Potential Adverse Impacts	Length of Time – short term during use and long term following closure	H, M, L, 0			
11. Economics	$/cubic yard including opportunity costs				

U = Unacceptable H = High impact
M = Moderate impact L = Low impact
0 = No impact

EVALUATION APPROACH FOR NEARSHORE-BENEFICIAL USE SITES (#2)
Working Draft – April 2000

Evaluation Factor	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
II. Beneficial Use					
1. Threatened and Endangered Species a. Federally Listed Threatened or Endangered Species b. States Listed Rare/Endangered Species or those of State Concern	For both categories assess • Presence – Absence • Relevant species description, range, and migratory patterns • Distance from site	U, H, M, L,0	Y	Y	~~No~~ - 0.
2. Cultural/Archaeological Resource Sites or Historic Districts	Presence - Absence, distance from site, expected degree of disturbance	H, M, L, 0			
3. Designated Conservation Areas a. Federally designated Marine Sanctuaries, Wildlife Refuges, National Seashores & Parks b. State designated Marine Sanctuaries & Preserves or Fish Havens	For both categories assess • Presence – Absence • Distance and downcurrent effect • Relevant species description and range	U, H, M, L, 0			
4. Navigation Considerations a. Marine Shipping/Transit Lanes b. Anchorage Areas & Harbors of Refuge c. Aids to Navigation d. Recreational Navigation	 Draft + propwash + buffer = minimum depth Presence – Absence Presence – Absence (assume safe radius) Draft + propwash + buffer = minimum depth	 Minimum depth feet U, 0 U, 0 Minimum depth feet			

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EVALUATION APPROACH FOR NEARSHORE-BENEFICIAL USE SITES (#2)
Working Draft – April 2000

Evaluation Factor	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
5. Existing Habitat Types a. Mudflats and Sandflats b. Spawning/Nursery Habitat c. Submerged Aquatic Vegetation d. Fisheries Feeding/Migration Habitat e. Benthic Habitat (i.e. unique, hard bottom, mussel, complex habitats) f. Wetlands	Distance to site, area, current dir. Distance to site, area, current dir. Distance to site, area, current dir. specific species info Presence – Absence – descriptive categories of habitats to avoid (unique features) Amount, type	H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L U, H, M, L, 0 H, M, L, 0			
6. Commercial and Recreational Fisheries a. Commercial Fisheries Harvest Areas b. Shellfish Propagation and Harvest Areas c. Aquaculture Sites d. Recreational Fisheries Areas	Distance, current direction, amount, type, value Distance, current direction, amount, type, value Distance, current direction, amount, type, value Distance, current direction, amount, type, value	H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L, 0			
7. Site Characteristics a. Physical Area b. Site Capacity c. Current Patterns, Water Circulation d. Exposure to Storm Events, boat wakes e. Ambient Sediment Conditions/Type f. Bathymetry	Size of site (square footage) Capacity of site (cubic yards) Ranges of near-bottom current velocity, potential for change Wave climate Categories: depositional, reworking, erosive Depth	Minimum size Minimum capacity U, H, M, L, 0 U, H, M, L, 0 H, M, L, 0 H, M, L, 0			
8. Site Accessibility a. Route b. Location c. Logistics	Transportation conflicts Distance from site Utilities, etc.	H, M, L, 0 H, M, L, 0 H, M, L, 0			
9. Engineering Considerations	Geotechnical stability, foundation requirements				

EVALUATION APPROACH FOR NEARSHORE-BENEFICIAL USE SITES (#2)
Working Draft – April 2000

Evaluation Factor	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
10. Site Use Conflicts a. Military Practice, Research or Restricted Areas b. Extractable Resource Present c. Utilities (Submarine Pipelines and Cables) d. Public Beaches and Parklands e. Other Commercial Uses f. Recreational Uses	All categories assess • Presence – Absence • Distance from site • Aesthetics • Timing of disposal • Zoning	U, H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L, 0 H, M, L, 0			
11. Beneficial Uses	Potential for marine habitat or port facilities – amount, type, value				
12. Duration of Potential Adverse Impacts	Length of Time – short term during use and long term following closure	H, M, L, 0			
13. Economics	$/cubic yard including opportunity costs				

U = Unacceptable H = High impact
M = Moderate impact L = Low impact
0 = No impact

EVALUATION APPROACH FOR UPLAND SITES (#3)
Working Draft – April 2000

Evaluation Factors	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
III. Upland Sites					
1. Threatened and Endangered Species a. Federally Listed Threatened or Endangered Species b. States Listed Rare/Endangered Species or those of State Concern	Presence-Absence Distance/Migratory patterns Species description/range	U, H, M, L, O			
2. Cultural/Archaeological Resource Sites or Historic Districts	Presence - Absence Proximity Degree of Disturbance	H, M, L, O			
3. Conservation Areas, Open Space Land, Recreational Areas & Natural Reserves a. Federal Wildlife Refuges b. State-designated Reserves c. Public and Non-Profit Areas d. Private Areas and Heavily Wooded Areas	Presence - Absence Proximity, Distance	H, M, L, 0			
4. Existing Habitat(s) at Site a. Successional Stage b. Degree of Disturbance c. Landscape Position d. Wildlife Function or Use	Presence-Absence of T&E Species Degree of Diversity Uniqueness Regional Corridors/Range of Species	U, H, M, L, O			
5. Groundwater Quality a. Sole Source Aquifer b. Wellhead Protection Zones	 Presence/absence Type of Zone	 U/0 H, M, L, 0			
6. Surface Water Quality a. Relation to Water Supply Watersheds b. Rivers	Location/proximity/distance relative to WS groundwater WQ classification Anadromous/catadromous fishery	U/O H, M, L, 0			

EVALUATION APPROACH FOR UPLAND SITES (#3)
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Evaluation Factors	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
7. Site Characteristics a. Physical Area of Impact b. Site Capacity c. Site Protection Requirements d. Existing Terrain e. Subsurface/ Substrate f. Floodplains g. Wetlands	 Size/area/depth Volume of material Fencing, other security Slopes, soils Geology Presence by type Presence by type	 Min. acreage, depth (ft) # CY Potential Degree/type Stability/compaction Zone - U, H, M, L, 0 Acreage - U, H, M, L, 0			
8. Engineering Considerations a. Utility Crossings b. Dewatering & Rehandling Area Availability & Adequacy	 Number/type Acreage/proximity Down gradient receptors	H, M, L, 0			
9. Site Use Conflicts a. Military Practice, Research or Restricted Areas b. Public Parklands and other Recreational Uses c. Commercial Uses d. Residential Uses e. Agricultural soils	Presence - absence Distance Views/scenic quality; Active/Passive; Timing/Duration Odors, Dust, Aesthetics, Noise Prime or unique farmland	U/0 H, M, L, 0 Presence, acreage, uniqueness			
10. Present and Projected Land Use, Including Adjacent Areas	Zoning, master plans Compliance, conformance Incompatibility Sensitive receptors	U/0 H, M, L, 0 #, type, proximity			
11. Site Accessibility a. Route b. Location c. Logistics	 # crossings/clearances Distance from source/disposal site Timing, rehandling limitations/conflicts	 # Miles H, M, L			
12. Availability for Use a. Land Acquisition b. Potential Extractable Resources	# of parcels/owners Cost Value/Opportunity Costs	# $ Other uses/$			

EVALUATION APPROACH FOR UPLAND SITES (#3)
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Evaluation Factors	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
10. Socioeconomic/Environmental Justice a. Population b. Demographic groups c. Income	 # within a distance % minorities, disadvantaged % low/mod income	 H, M, L. 0			
11. Duration of Impacts	Short-term Long-term Permanent, irretrievable	L M H/U			
12. Economics	Opportunity costs Implementation/management costs	Value of lost use $/acre and $/ cy			
U = Unacceptable H = High impact M = Moderate impact L= Low impact 0 = No impact					

EVALUATION APPROACH FOR TREATMENT TECHNOLOGIES (#4)
Working Draft - April 2000

Evaluation Factors	Scoring Technique	Metric	Appropriate Factor? (Yes/No)	Appropriate Scoring Technique? (Yes/No)	What Metric Value Screens Out a Site? (e.g., yds, acres)
IV. Treatment Technologies					
1. Site Accessibility a. Route b. Location c. Logistics	# crossings/vertical clearance Sensitive receptors along route, near site Proximity to source of material Handling, equipment needs and impacts	Cost and time #'s/types Distance Degree of complexity			
2. Site Characteristics and Land Use Conflicts a. Material Transfer Mechanism b. Conflicts with Surrounding Land Use	Distance from Water Access Distances/types of abutting uses	Miles H, M, L			
3. Site Availability & Acquisition	Capacity Complexity of acquisition Cost	Min. acreage # Parcels/Zoning $ - H, M, L			
4. Impacts and Effectiveness a. Airborne Discharge of Contaminants b. Noise of Operations c. Stability of Product d. Reduction in Contaminant Availability	Type, emissions, distance from sensitive receptors Decibels, distance, duration, intensity Contaminant isolation Contaminant elimination	U, H, M, L, 0 Yes/No/degree Yes/No/degree			
5. Feasibility/Practicability a. Dewatering Requirements b. Dewatering Effluent c. Proven Technology d. Commercial Application e. Ability to Treat Large Volumes f. Cost of Implementation	Scope of facility needed Contaminant discharge impacts Certainty of effectiveness Private sector interest in operation Rate of Treatment Cost/volume	Size H, M, L H, M, L Yes/no Timing/volume of material $ - H, M, L			
U = Unacceptable H = High impact M = Moderate impact L = Low impact 0 = No impact					